PUBLIC LIBRARY

AMERICAN MACHINIST

A JOURNAL FOR MACHINISTS, ENGINEERS, FOUNDERS, BOILER MAKERS, PATTERN MAKERS AND BLACKSMITHS.

VOL 11, No. 41. WEEKLY. | NEW YORK, OCTOBER 13, 1888. | $2.50 per Annum. SINGLE COPIES 5 CENTS.

COPYRIGHT 1888, BY AMERICAN MACHINIST PUBLISHING COMPANY. For Sale Everywhere by Newsdealers. ENTERED AT POST OFFICE, NEW YORK, AS SECOND CLASS MATTER.

New Oscillating Engine.

The illustration represents a new design of an oscillating engine. The aim of the designer was to obtain great simplicity, and also to overcome the objectionable features heretofore found in many ordinary oscillating engines, namely, excessive wear, and leakage around the trunnions; which, it is claimed, and we believe justly so, has been successfully accomplished; and in the meantime, bringing out a neat, compact and simple engine, as the illustration shows.

On account of the small amount of space required for this engine, its simplicity, and the ease with which it can be reversed, it is especially applicable to small steamers, and pleasure yachts.

The valve is cylindrical in shape, and fits into a cylindrical steam chest, which is turned upon the outside and forms one of the trunnions upon the cylinder. Through the stuffing-box in the center of the steam chest cover, and in a line with the trunnions, the steam pipe is passed, having on its inner end two projecting studs that fit into a recess in the back of the valve. Clamped to this pipe, outside of the steam chest, is the reversing lever, which can be locked to the frame in such positions as to determine the forward or backward motion of the engine. It will thus be seen that the valve has end movement sufficient to allow the steam to keep it against its seat, while it is prevented from vibrating with the cylinder by the projecting studs on the steam pipe. The valve remaining at rest and the cylinder oscillating, causes the steam and exhaust passages of cylinder and valve to alternately register with each other.

Constructed upon this principle there is no leaking of steam around the trunnions or between cylinder and chest.

For engines of this class, which are to be used in manufacturing establishments, an automatic governor is provided that acts directly upon the valve, thus insuring regulation of speed under variations of load. For engines which are to be used in steam launches, the base is made much lower than the one here illustrated, which enables them to be placed very low in the boat—a very important consideration. These engines are made by John D. Bowne, Jamesburg, N. J.

NEW OSCILLATING ENGINE.

Clocks to the value of $1,392,647 were exported from the United States during the year 1887. And these clocks were sold in competition with those made in Switzerland and Germany by workmen receiving only a fraction of the wages received by the Connecticut workmen. It is plain, however, that the American workman must make more clocks in a given time than his foreign competitor. The American clock must cost less to make, or it would suffer in the competition.

The above facts furnish a very forcible illustration of the advantages resulting from the employment of intelligent and high-priced labor, working with the best of machinery and tools.

Ship-building on the Delaware River is looking up. It is said that, with work now in hand and orders that are sure to come, the leading firms will have work for two years.

During the month of August there was an increase in the output of the blast furnaces of the country equal to a little more than five per cent. of the total product.

The Cunard Steamship Etruria, looking in vain for a better record than her own to beat, has taken five minutes off that. Her last passage to New York was made in six days and two hours.

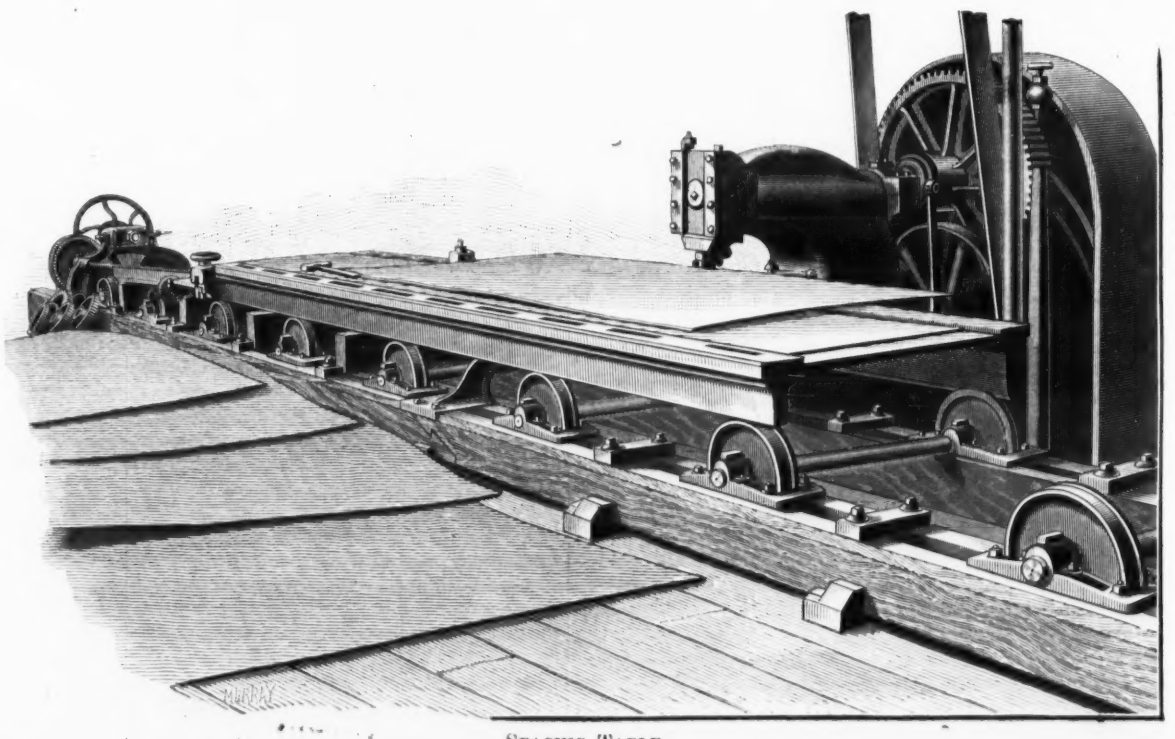
There are twenty one cotton mills in Japan, the number having more than doubled during the past two years.

Spacing Table.

The machine which we illustrate herewith has been designed with an especial view to meeting the want so long felt by boiler makers and others, of an accurate spacing machine, to be used in connection with the punch in a boiler shop.

The cuts on this and the following page show the principle of construction. A screw is placed in a fixed iron frame at an angle to the travel of the carriage. Upon this screw is a nut, swiveled in a sliding block. As the nut passes along the diagonal screw, the sliding block, through which the motion is given to the carriage, is carried in an adjustable radius bar transversely to the travel of the nut along the screw. This radius bar may be set so that the carriage may be thus moved by the revolution of the screw a greater or less distance than that due to the pitch. This variation is indexed, and the amount laid down in a chart showing the pitch in decimals; this chart being sent with each machine. The screw of two-inch pitch is revolved by means of cut change gears, so as to give approximately the required pitch of the holes, the finer adjustment to the exact pitch being secured by the adjustment of the radius bar. The radius bar with its sliding nut gives an indexed variation of $\frac{1}{6000}$ of the distance traveled by the carriage, so that, with the bar properly set, an accumulated error cannot exceed one-half of that amount. The length of the table being 18 feet, the greatest possible error between extreme holes would be $\frac{18}{1000}$ of an inch, which is practically of no importance. Even this, however, may be eliminated by allowance on the index, or the exact pitches obtainable may be laid down in the specifications worked to.

The mode of operating is to divide the distance between centers of extreme holes required, by the number of spacings between the holes. The quotient so obtained is looked for in the chart, and the index on the machine set to correspond, using the gears also found on the chart. For instance, it is required to punch 51 holes in a plate of iron, the extreme holes to be 100½ inches apart. The number of spaces or movements of the table will be 50, or one less than the number of holes. Divide 100½ by 50, the quotient will be 2.01; these holes will therefore be 2.01″ apart. By reference to the chart, pitch 2.01 will be found to require gear number 64 and the index set at 90. The corner hole is then located and punched, the hand-wheel brought to the starting point, the sheets squared with the table, clamped down and punched off. The last hole will be found the exact distance required from the first, without the use of templates or regulators, and without running the carriage along to see whether the work is coming out right. This punching may be done equally well in either direction, it being common practice to punch for double riveting by



SPACING TABLE.

going through and back, merely resetting the plate to be punched. The change of gears requires but a few moments. The proper index number and gear number may be entered in the specification books of the shop, to facilitate subsequent duplication. No boiler maker need be told the amount of labor saved by accurate punching, or of the improvement in quality of work. Laying out may be mostly dispensed with in straight work, and its correct work infallibly detects errors and leads up to a systematic and uniform shop practice in this important branch of boiler work. The differences in measurement between inside and outside courses having the same number of holes can be accurately spaced off for varying thicknesses, and as accurately punched.

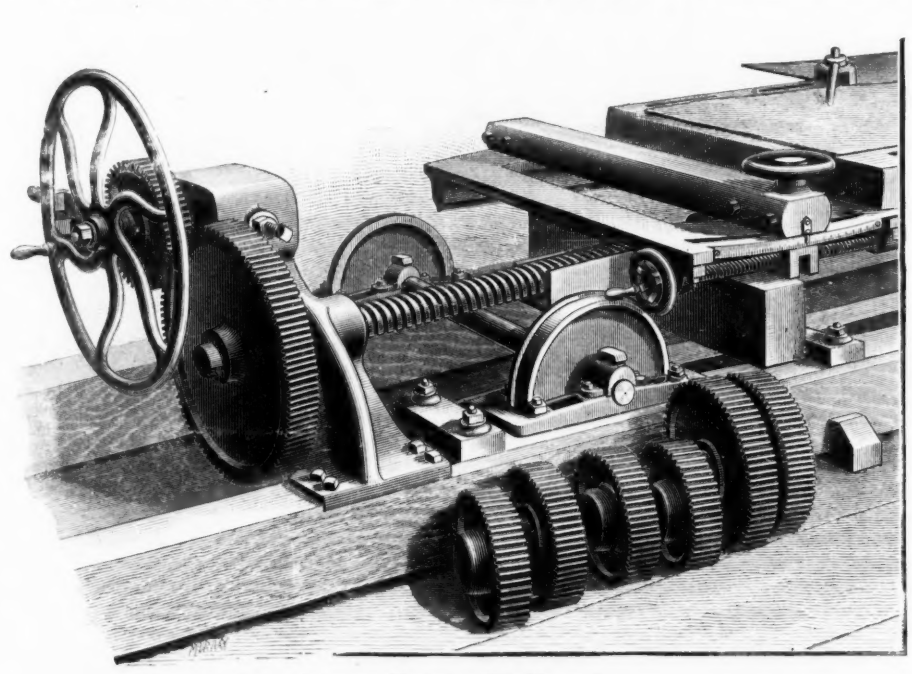
The machine is the invention of Mr. H. R. Barnhurst, and is made by the Stearns Manufacturing Company, of Erie, Pa.

Mr. E. P. Bullard, of the Bridgeport Machine Tool Works, writes us to say that the credit of the design of the level which we illustrated in our issue of Oct. 6 was not due to him, as we supposed, but to Messrs. Keuffel & Esser, of New York, who designed and made it to fill his order for a fine level to meet certain requirements.

Shop Notes.

THE UNION METALLIC CARTRIDGE CO.'S WORKS.—MR. A. C. HOBBS.

Without doubt, one of the most interesting places in this country for a mechanic to visit is the works of the Union Metallic Cartridge Co., at Bridgeport, Conn. Hundreds of machines are there of marvelously ingenious construction, and operations which, before visiting the works, would be deemed scarcely possible by automatic machinery, are here performed with an apparent ease which is a source of continual surprise and wonder. The operations of making the many varieties of cartridge shells of copper and brass are performed by drawing presses, which are constructed and work much upon the principle of other presses for work of a similar nature, except that they are made to work automatically as far as possible. Most of those which do not work entirely automatically are provided with circular plates, having a number of holes drilled through them near the outer edge, into which the blanks, which have previously been punched out and partially formed at a single operation, are placed by an attendant. At each stroke of the press this plate is carried around one notch, thus bringing one of the holes, containing a blank, over the die. This system of feeding the blanks is employed all the way through for most of the sizes, and enables the machines to be worked much faster than if an operator were required to place a blank over the die during each upward stroke of the punch, since there are always a number of holes in the plate, which may be filled as it revolves, and all of the time is available for the placing of the blanks in position, instead of only a fraction of the time of each stroke. For some of the operations on the center fire shells, these revolving plates are provided with steel studs upon which the shells are placed by the attendant, and from which they are automatically removed after passing under the punch and being operated upon. On some of these machines there are two punches, so that two successive operations are performed at each stroke, the one being in most cases in the nature of a preparation for the other. At each descent of the punches one of the studs, carrying a shell which has been operated upon, is brought under the end of a bent tube, which passes over the shell, and, rising, carries it up; each shell as it is pushed into the descending tube forcing another shell out of the other end into a box placed to receive it. Of course, it is manifestly impossible to give a detailed description of all the interesting machines and operations. They must be seen to be understood and appreciated. The machinery is all the finest of its class, most of it designed and built in the shops of the company, and evidently no pains or expense spared to make it as nearly perfect as possible.



Spacing Table.—See Page 1.

Among the machines which especially attract attention are those for making small percussion caps. A strip of the sheet copper from which they are made is placed in a roll at one side of the machine, and automatically fed over the dies and rolled up again on the other side. There are a number of dies and punches, and at each stroke of the machine each punch forms a cap, punching out the blank, which, in this case, consists of a round disk equal in diameter to the size of the cap, and which forms the top, having four radiating arms, which, when pressed through the die, are closed up to form the sides. These machines work entirely automatically. As the caps come from the machine the edges are somewhat rough and irregular, and one of the most wonderful machines in the establishment is devoted to making them smooth. They are thrown promiscuously into a hopper, a peck or more at a time, and this machine takes them, one by one, turns them the proper way, and forces them down by means of a small punch, into a chuck, which is upon the upper end of a vertical spindle. They are forced into this chuck to a certain definite depth and the punch withdrawn, when, the spindle carrying the chuck is put in rapid motion, a cutting tool advances and trims off the edge of the cap, much the same as it would be done by a workman in an ordinary lathe; after which the cap is released, falls into a box, and the spindle stops ready to receive another. All this is of course done very rapidly, dozens of them being turned off in the time required to read this description of the motions, and the machine is entirely automatic, requiring only that the hopper shall be kept filled with rough caps.

Some of the shells require to be annealed several times during the forming, and the machine used for the purpose is an interesting one, consisting of a revolving plate upon which the shells are placed by an attendant, so that they stand on end in a circle, at a little distance from the edge of the plate; the placing them in this circle being facilitated by a piece of sheet metal, bent to conform to the proper circle and standing up on the side next the operator, but not turning with the plate. The shells are placed against this, and of course, as the plate revolves, are carried beyond it, and then stand in a true circle. When the motion of the plate brings them round to the other side, they pass between two rows of Bunsen burners, which heat them to the proper temperature, after which they are guided off into a box and allowed to cool. The above are only a few of the many interesting machines to be seen there, but which time and space forbid the mention of in detail.

Not less interesting than the wonderful machinery in this establishment is the wonderful man who is the superintendent of it, and who has designed most of the special machines. This is no other than Mr. A. C. Hobbs, whose exploits in opening the best locks that could be produced by English makers at the London exhibition in 1851 gained for him a world-wide fame, and did much to attract attention to American ingenuity and skill. Mr. Hobbs is now 76 years old, and, however wonderful his feats of lock-picking may have been, they are at least fully equaled by his present feat of personally superintending, at that age, such an establishment as the U. M. C. Co's works, employing as it does some 1,500 to 2,000 hands, constructing and using the most intricate machinery, and consuming yearly something like 850 tons of sheet copper, besides vast quantities of brass, lead, paper, fulminating materials, powder, etc.

Mr. Hobbs has had a varied career, having been engaged in a good many different enterprises before finally settling down into his present position.

His father dying when he was three years of age, he, as soon as he was able, did what he could for the support of his widowed mother, and, at ten years of age, left his home, which was in Boston, and went to work on a farm; four years later, returning to Boston, he obtained a position in a dry goods store, but soon after went to learn wood carving. This did not suit him and he left it; subsequently trying several occupations, including carriage body making, carriage painting, life before the mast, tin plate work, coach trimming and harness making.

As he himself says, however, he never went beyond the elementary rudiments of most of these handicrafts, but finally served an apprenticeship at glass cutting, and established a business of his own in that line; being led to the study of the construction of locks, from the fact that a part of his business was the cutting of glass door knobs, which were much used at that time.

During this time he invented and patented an improved method of attaching these knobs to the locks, and this bringing him in contact with the lock makers, led to his entering into the lock business, under the firm name of Jones & Hobbs. Some years afterwards he gave up this enterprise and entered into an arrangement to open a store in New York for the sale of the Edwards & Holman locks and fire-proof safes.

He subsequently became acquainted with a firm at that time prominent bank-lock makers, and made arrangements with them to take entire charge of the sale of their locks. In order to promote the sale of these locks, it was of course necessary to convince prospective customers that the locks in use by them were not entirely trustworthy, and, as the most practical way of demonstrating this, he adopted the plan of opening their locks within a specified time, upon condition that his lock should be substituted for them.

In this he was very successful, and opened the locks upon most of the bank doors and vaults of the country, having studied their construction thoroughly, and made a very efficient set of instruments for the purpose.

Among the other locks opened, and as a result removed to make room for one of the kind he was selling, was the lock upon the vaults of the United States Treasury.

In 1848, while in Lancaster, Pa., putting on a lock which he had sold to a bank there, his attention was called by the cashier to an advertisement in one of the New York papers, of a Mr. Woodbridge, of Perth Amboy, offering $500 to any one who would within thirty days, using instruments of his own, open one of Mr. Woodbridge's locks which was upon a safe in the Merchants' Exchange reading room in New York. Or, he would let any one who chose to make the trial, have the use of the key for one dollar per hour, first having the movable bits taken out and distributed. There being 12 bits to the key, this would give 479,001,600 changes, or different ways of putting the bits together, only one of which would enable the lock to be opened by the key. Mr. Hobbs accepted the challenge, a check for $500 was placed inside the safe and locked up, Mr. Hobbs agreeing to open the safe without injury to the lock (in which event the check was to be his), or, at the end of thirty days, certify in writing that he was unable to open it, and that he considered the lock a safe one, and recommended it to the public as such.

The lock had been so constructed that any attempt to withdraw the bolt before the tumblers were all in their proper positions would result in fastening the instrument or key by which the attempt was made into the keyhole, thus making the opening of the lock impossible.

Mr. Hobbs elected to use his own instruments, and, commencing at nine o'clock in the evening, after the room was cleared, at half-past eleven he had the measurements of the required position of the tumblers all marked out, and the bolt ready to be withdrawn.

Leaving in the keyhole during the night a piece of wire with which he could withdraw the bolt, he notified the parties interested to be present at ten o'clock the next morning, telling them that "there was something the matter with the lock." At the appointed time he, in the presence of numerous interested spectators, opened the lock and received the check.

Going to England in 1851, he exhibited his locks at the World's Fair, and opened with apparent ease many locks of English make, which it had been believed to be impossible to open except with the key in the usual manner. Among these was the famous Bramah lock, which had for a long time been exhibited in the window of the maker, with a card offering 200 guineas to the one who should open it without injuring it. This he accomplished in 51 hours' actual working time. This made him the lion of the day, and he was called upon at the Exhibition and his locks examined by most of the notable people of the country, including the royal family, even to the Queen and Prince Albert.

He became a member of the Society of Arts, and by request gave a lecture before it, on the subject of ancient and modern locks. He was also made an Associate of the Institution of Civil Engineers, and by it was awarded the Telford medal, the highest honor given by that body, and the third one brought to this country.

In connection with others he then established a lock manufactory in London, which, though he sold out his interest in it in 1861, is still carried on there under the name of Hobbs, Hart & Co.

Returning to this country in 1860, he went to Bridgeport and took charge of the Howe Sewing Machine Works, which were then being built, the completion of the buildings and the fitting up of the machinery being done under his supervision.

Severing his connection with Howe in 1865, he, a few months afterwards, took the position which he now holds, and which, notwithstanding he has passed the age at which most men continue to carry on such enterprises, he

seems to bid fair to occupy for years to come. He seems able to still get much enjoyment out of life, taking considerable interest in sailing his boat upon the Sound, and relating with great gusto his trials of speed with other craft.

During a trip through the works with him, it is evident that he is upon excellent terms with the employes and is personally acquainted with many of them.

A Machinist's Sermon.

By Jarno.

1.

Text: "Let us judge others by ourselves."

It has often been said that we should not judge, lest we may be judged, or that we should not judge others by ourselves. When a boy, one of the most conclusive things that could be said against me, in any little argument, was, "You are judging others by yourself." This is a mistake. Scientifically, we must judge others by ourselves. Making mental comparisons is as natural as it is to think at all. As well might we ask a thermometer to judge of heat by anything other than the mercury, or spirit, contained in its tube, as to expect anyone to go outside of himself in forming opinions.

What I purpose to say relates to things that are not as a machinist would make them, and which, of course, could be improved, in a machinist's judgment.

Figs. 1 and 2 are not unusual forms of the thumb-pieces of gas cocks. The corners of *A* and *B*, Fig. 1, are quite sharp. The reason that *A* and *B*, Fig. 2, are not so sharp, as if cut with a die, appears to be because metal cannot be cast quite so sharp as it can be cut. It needs not a trial to prove that these are as painful pieces of mechanism to be turned by the thumb and finger as could be well devised. These are the worst cases of gas cock thumb-piece that I ever saw; I hope there are none worse. They are graded all the way towards the better, until they reach a mild state of abomination, in the higher priced cocks, which are smoother, and their shape is more seemly, evidently, because the maker wanted a form that he could finish with an emery wheel. Machinists are ahead of the gas fixture makers in this matter. The thumb-pieces used in machinery are made with the idea that they are to be moved with the thumb and finger. This can be seen by a glance at the list of any of the drop-forging makers.

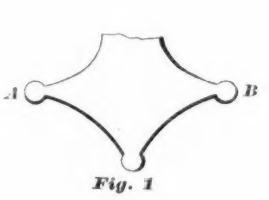


Fig. 1

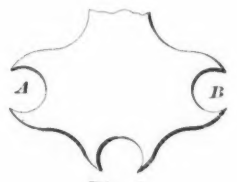


Fig. 2

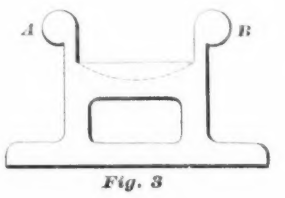


Fig. 3

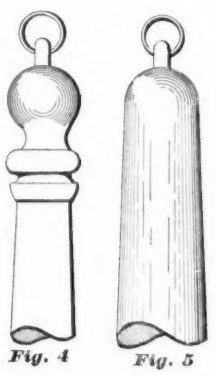


Fig. 4

Fig. 5

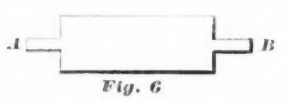


Fig. 6

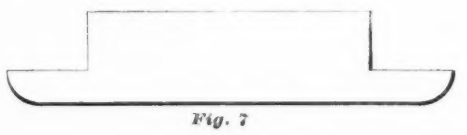


Fig. 7

Again, the screw heads in the keys of gas cocks are altogether too small. Being of soft brass, they would be rather small if made as large as the key washers. Instead of this, they are only about half the size of the washers. Then the screw-driver slots are too small and are not deep enough. Whenever a machinist has occasion to tighten the key of a gas cock, he well knows the fault of which I am speaking.

My window curtain is raised by a cord that runs under a wheel or sheave, at the window ledge. The wheel is held by a small frame. In this frame, the opening that contains the wheel is about twice as wide as the wheel, leaving space enough for the cord to go between the wheel and the frame. In the manufacture of such fixtures the frame pattern should be wide enough to have every wheel and every frame assemble, without a wheel binding in a frame. But in this frame and wheel too much allowance was made for bad foundry work.

Some curtain rollers are too short for the width of the curtains. If the curtains were made of sheet steel, that would wind upon the rollers without stretch or shrink, there might be no trouble; but as curtains are, when raising them constant care must be given that they do not run to one side and strike one of the brackets that hold the roller bearings.

The chair near me needs repairing. It is a cane-seat chair. The corners of the frame, into which the cane is woven, are quite sharp, giving the cane a quick turn or bend. So far as I have seen, the cane of chairs always gives out at the bend. Now, a machinist would not leave the corners sharp, but would make the chair with some view of having it wear as long as practicable. If a matter of rounding the corners of the frame would give the cane another year's lifetime, he would not hesitate to give it this year, even though he lost the chance of repairing. Gascon believes that the furniture makers purposely leave sharp corners, so that the chairs may soon come back to be repaired. I would not go so far as this, though I have considerable respect for Gascon's opinions.

Speaking of sharp corners, the holes of some buttons are made specially sharp. They appear to have been punched from the back side, so as to leave the sharpest corners where the thread bears. In the matter of cutting the thread, these buttons are a success.

Stepping out doors and taking a walk, I notice that pieces are broken out of the corners of stone steps and posts. Years ago, sharp corners in machinery were considered as evidences of good workmanship, but for some time there has been a change of opinion. In all machinery of the better class, the corners of the parts are rounded wherever practicable. I admit that there may not be quite so many reasons for rounding the corners of stone work as there are for those of machinery. The corners of parts of machines are rounded for at least three reasons: they are not so likely to get bruised; they are easier to handle; they look better with round corners. In stone work, if the corners are always sharp, I would not assert but that they would be as good looking as if rounded; but, so long as they always get broken off, I should think it better to borrow an idea from the machine shop and round them at first, and thus avoid the breaking.

I see an iron fence whose pickets were once fastened in stone bases. I am sorry to see so many of these pickets left without support, on account of the stone breaking away. Sometimes a stone is cracked for several feet along through the picket holes.

The worst case of broken-off corners on stone posts that I have seen is in the balustrade, or fence, in front of the Boston public library building. Boston is a place that I like so well, it is with regret that, as a machinist, I am compelled to offer anything in criticism.

Many foot scrapers upon door-steps are something like Fig. 3, having once had lugs on the sides, like *A* and *B*. The use of these lugs it is not easy to tell. They may be for a guide to the foot when scraping. Is such a guide needed? The wives of some of us might think that a homeward-guide mechanism attached to our feet would be a good thing, but after we have reached the door-step it would appear that no farther guiding of the feet is needed. Whatever may be the use of the lugs, it is not fulfilled, because so many of them are broken. When the lugs are not broken off, the tendency is to wear the scraper hollowing, as shown by the dotted line, and make it not good for use. The lugs should either be made stronger or not made at all.

Houses of the better class are sometimes supplied with coal through holes in the sidewalk. These holes are usually stopped by cast-iron covers, and some are surrounded each by a stone—I should say pieces of stone, because so many are broken. A common rule in making machinery, when parts frequently break, is to make them either heavier or of stronger material.

My rambling has brought me into the suburbs, where I find quite a number of hitching posts, made of wood instead of stone or iron. I suppose that a horse will be as slow in changing his nature as man has been, and that while a horse remains as he is, he will generally bite any tree or hitching-post that he can reach. Many of the hitching-posts were made, each, something like Fig. 4; that is, there were several beads, the post ending in a ball at the top. Hence, the post presented several projections that the horse found it convenient to reduce. After reducing them he left a very unshapely post. When made of wood, I suggest that posts hereafter be turned plain, on a slight taper, with a hemispherical end, like Fig. 5.

A common form of blind slat is like Fig. 6, with trunnions *A* and *B*. The trunnions are often broken—so often that there are in the market cast-iron trunnions for repairing. The wooden trunnions should be larger. They may not, then, be quite round, but they will be near enough round to stay in their places.

In returning, I go by a savings bank building—one of the finest in the city. The first step from the sidewalk is of stone, and shaped like Fig. 7. Here we have a violation of a plain rule in making machinery: in any piece, do not have a part very small where it joins a larger part, and do not have a sharp corner at the juncture. The step has done just what a machinist would expect it to do—broke. It is to be hoped that this is no indication of the condition of the bank.

Pieces are often broken out of cast-iron fences. The fences appear to be heavy enough, and they would probably not break if the iron were properly distributed. To a man of correct taste, it cannot be other than painful to see a broken fence in front of an elegant house. Again Boston comes back with its pleasing reminiscences, but with them the tinge of pain, because of the memory of the broken balusters in front of the library building. The overpowering case of broken cast-iron fence is in front of the parson's house. In this there are figures of angels; some have lost the upward-pointing finger; some have unjointed a forearm; some are headless, while others have shed a wing. S. A. Smith smiles when he thinks of the incongruity of representing a halo around the head of a supernatural being by a piece of brass wire—a thing that can be unreeled from a coil, cut-off, hammered and soft-soldered! It would seem that we have reached the true home of the incongruous when we come to the house of the preacher, surrounded by broken-headed and broken-winged cast-iron angels. The executioner said to the condemned one, "Come with me and I will make an angel of you." I wonder whether the preacher's angels are any that the executioner made.

It is said that some notable improvements in things connected with an industrial art, have at times been made by men not engaged in the art. To this the making of machinery is not an exception. Having criticised things not made in a machine shop, I ought to be willing to have some one come into the shop and suggest improvements. I am not quite so willing to have this done, as I am to preach to others; yet I will accept all suggestions with as good grace as I can command. Let us remember that to look wise and suggest a change does not always mean an improvement.

This is the end of Sermon 1.

It is said the electric light boom has had the effect of bursting up a good many gas companies in different parts of the country. In this world this is what frequently happens to people whose habit of mind or want of thought disposes them to be over-conservative. In these instances the gas companies have allowed others to get ahead of them. They have worked upon the idea that the world is standing still. There is room for improvement in gas service, but many gas companies have, apparently, never thought of this. When the electric light has demonstrated its superiority, these gas companies, instead of improving their service, have kept right along in their old ways. Their patrons have seen the difference between the purpose of the electric light companies to please those who patronize them, and the lack of all effort on the part of the gas companies to please those who deal with them. There are gas companies that have grasped the situation, and have added electric lighting to their plants, and have also improved their gas service. These companies have not failed. They are in the line of progress, and there is no reason why they shall not succeed.

There is not a city in the country where the condensed exhaust from steam engines cannot be seen raining down from the tops of exhaust pipes on the roofs of buildings. This usually carries with it more or less oil, used in lubricating the cylinder, which falls with the water, to the discomfiture of passers by. If this were unavoidable it might be borne, like any necessary evil. But there are plenty of devices that, for a trifling cost, will prevent the nuisance of water and oil spray. This being so, it would be no hardship if users of steam engines so located that the exhaust may be a nuisance were required to use one or the other of them. In addition to protecting pedestrians, such a device will, in most cases, pay for itself every year in preventing damage to roofs and other property.

The absolute mean deviation of the new magazine rifle for the army is only a little over a foot at 1,000 yards. Using a fixed sight a man can be struck up to 470 yards, as the trajectory is remarkably flat. The authorities do not at present propose to make use of a smokeless powder, as the keeping properties of these compounds in warm and damp climates has not as yet been tested. Lobel rifles are being manufactured for the French army at the rate of 1,600 a day.—*Engineering.*

What is probably the tallest smoke chimney in the world is now being completed at East Newark, N. J. The base diameter is 28 feet. It is solid brick to an altitude of 310 feet. At its top it is 9 feet in diameter. A cast-iron rim 20 feet in diameter, and a bell, surmount the whole, and make the total height of the structure 335 feet. One million, seven hundred thousand bricks were used in its construction, and it cost $85,000.—*N. Y. Times.*

According to law, all steam cars in the State of New York must be heated by steam after November 1st, unless the company is relieved by the railroad commission. But the roads appear to be no nearer steam heat than they were when the law was enacted. They are applying to the commission for relief, and it is safe to say they will continue to do so as long as they get it. There has been very little effort to supplant the car stove.

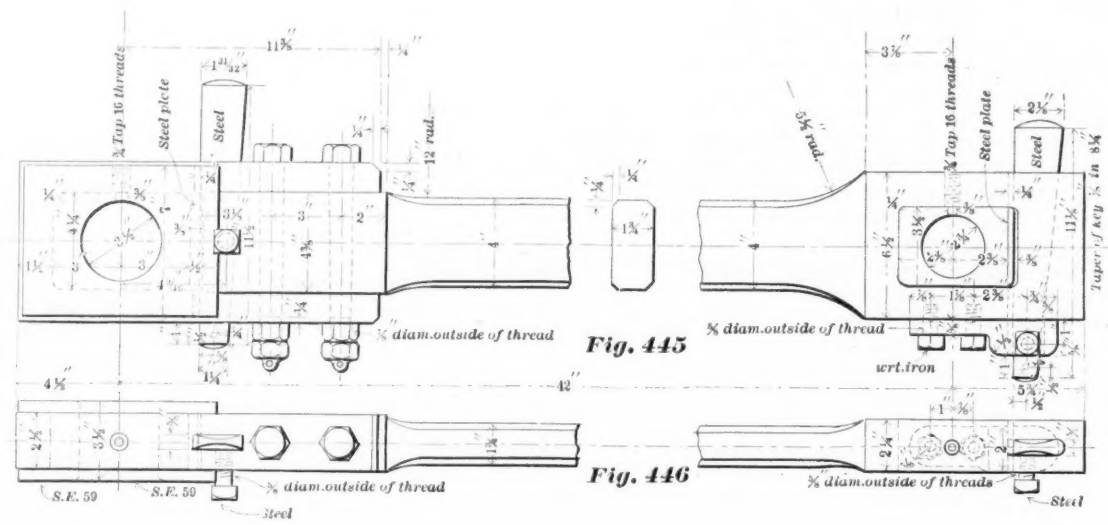
Modern Locomotive Construction.

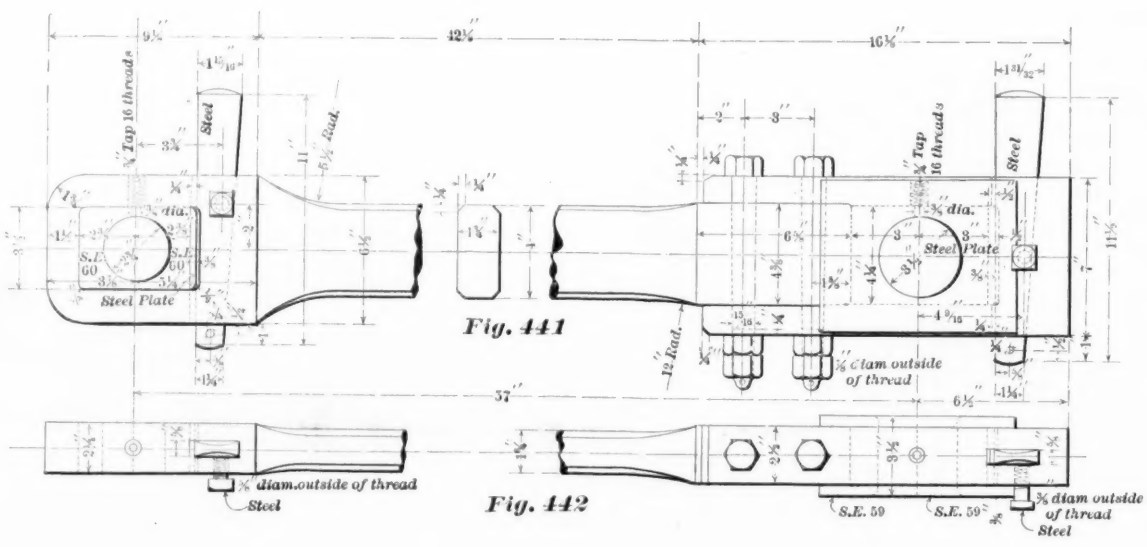
By J. G. A. Meyer.

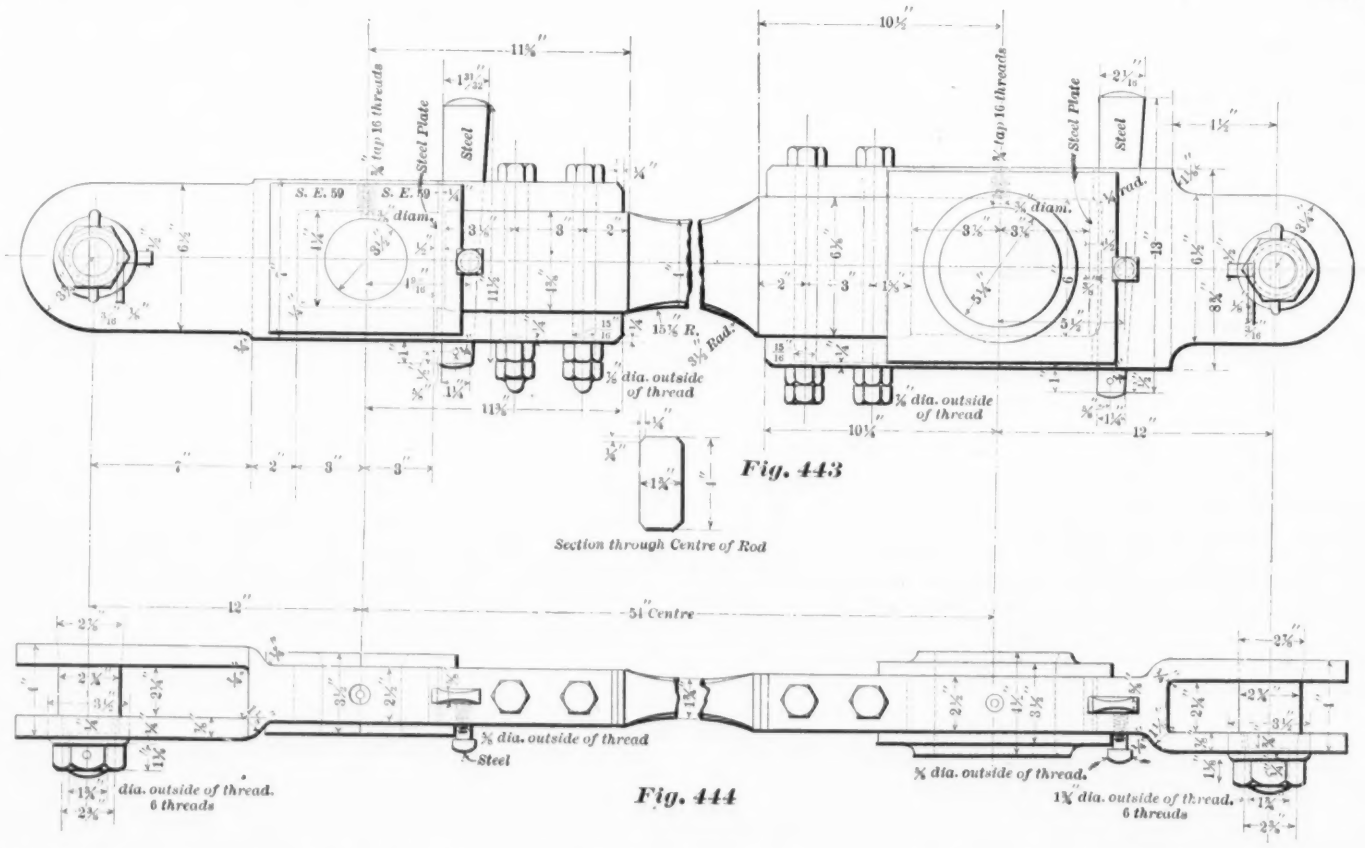
SEVENTY-FIFTH PAPER.

Side rod straps for eight-wheeled passenger engines.—In comparing the side rod straps belonging to different locomotives of one and the same class and size, but designed in different locomotive establishments, or by different master mechanics, we find quite a variation in the dimensions of corresponding parts of the different side rod straps around similar crank-pins. This is, no doubt, due to the fact that it is impossible to determine exactly the magnitude of the forces to which the side rods are subjected.

We have already seen that the main rods are subjected to a tensile force, and also to a transverse force due to the centripetal acceleration at one of its ends. The side rods are subjected to similar forces, but whose sum is of less magnitude than that of the forces acting on the main rods. Again the magnitude of the tensile force acting on the main rod is dependent on the whole pressure on the piston, whereas on side rods the magnitude of the tensile force is partly dependent on the pressure on the piston, and partly dependent on the condition of the road bed, also on the condition of the working parts under the engine; but these conditions will affect the tensile force acting on the side rods to a greater degree than it will affect the tensile forces acting on the main rods. If, for instance, the road bed is not level, or the play between the axle box and the wedges has been increased by wear, or the engine is running over a sharp curve, the driving axles, as well as the side rods, may at any time be thrown out of line with each other, thereby suddenly increasing the tensile force on the side rods on one or the other side of the engine; and when, under these conditions, the engine is running at a high rate of speed, this extra tensile force will act with greater intensity on the side rods than on the main rods, because the latter rods will be assisted by the stored up energy in the engine to turn the wheels. Now, with these emergencies to provide for, it should not be a matter of surprise to hear of straps breaking; but the frequency of such occurrences can be avoided by basing our calculation on the designs of such straps which experience has taught us to be correct.







In designing a side rod strap we are guided by the same reasoning as that given in connection with the design of the main rod straps, and therefore conclude that the weakest part of the side rod strap is in the plane $x\ y$ (Fig. 422) passed through the axis of the bolt. Since the width of the side rod strap depends upon the dimensions of the crank-pin, we shall consider that the width has been given, and all that remains for us to determine is the thickness g (Fig. 421, last paper) of the wing of the strap.

In eight-wheeled passenger engines two driving wheels are connected on each side of the engine; consequently, each main rod in this class of engines has to transmit motion to two driving wheels; and the side rod has to transmit motion to only one driving wheel. The main driving wheels generally have to support a greater weight than the rear ones, as the former have to support a portion of the weight of the connecting rods, a portion of the weight of the valve gear, and often have a heavier counterbalance than the latter; but for the purpose of finding the proportions of the side rod straps, we may assume that each driving wheel, whether front or rear, supports an equal amount of weight. Again, the whole of the total steam pressure on the piston is not utilized for the purpose of giving motion to the driving wheels; yet for the sake of simplicity we may assume that such is the case. Now, in order to simplify matters still more, we may again assume, as we did in relation to the main rod, that the side rods are subjected to a tensile force only. Consequently, since the main rod in eight-wheeled passenger engines has to transmit motion to two driving wheels, and since the side rod is, so to speak, only a connecting link between these two drivers, and therefore has only to transmit motion to one of them, it follows that, under the foregoing assumptions, the tensile force to which the side rods are subjected will be equal to one-half the pressure on the piston. Comparing the cross-sectional area in the plane $x\ y$ of the side rod straps, at present working successfully, with one-half of the steam pressure on the piston, we find that the stress per square inch of the cross-sectional area in the plane $x\ y$ of the side rod straps made by different makers, varies in round figures, from 3,500 to 4,700 pounds. Our experience leads us to believe that, for eight-wheeled passenger engines, it is good practice to make an allowance for a stress of 4,200 pounds per square inch of the cross-sectional area through the weakest part of the strap (that is, in the plane $x\ y$), under the assumption that the side rods are subjected to a tensile force only, and that the magnitude of this force is equal to one-half the steam pressure; and this stress of 4,200 pounds per square inch of the weakest part of the strap will be adopted in the following calculations. In our last paper it will be seen that for main rod straps the stress allowed per square inch in the plane $x\ y$ is 6,500 pounds, but in side rod straps we have now established a stress of 4,200 pounds per square inch in a similar plane. This difference is due to the fact, as stated before, that side rods are subjected to an additional tensile force when the engine is running over uneven road beds, curves, etc. Therefore, in order to find the thickness at g of the side rod strap (see Fig. 421), we divide the total steam pressure on the piston by 2; the quotient will be the assumed tensile force acting on the strap; dividing this quotient by 4,200 we obtain the number of square inches in the smallest cross-sectional area of the strap, that is to say, in the plane $x\ y$. Dividing this cross-sectional area by the width of the strap minus the diameter of the bolt, we obtain the sum of the thickness at g and g_2; one-half of this sum will be the required thickness at g. This manner of finding the required thickness can be made simpler, hence the following:

Rule 55. Divide the total steam pressure on the piston by 16,800; divide this quotient by the width of the strap from which the diameter of the bolt has been subtracted; the last quotient will be the thickness at g of one of the wings of the strap.

Example 90.—Find the thickness at g of the side rod strap for an eight-wheeled passenger

engine; cylinders 17 inches diameter, maximum steam pressure on the piston is 120 pounds per square inch; width of strap 2¼ inches; diameter of bolts through the straps, ⅞ inch.

The total pressure on the piston is equal to the product of its area in square inches into the steam pressure per square inch; consequently the total pressure on the piston will be

$$226.98 \times 120 = 27{,}237.60 \text{ pounds.}$$

Dividing this pressure by 16,800, we have

$$\frac{27{,}237.60}{16{,}800} = 1.621$$

Dividing this quotient by the width of the strap minus the diameter of the bolt, we obtain,

$$\frac{1.621}{2\frac{1}{4} - \frac{7}{8}} = 1.17 + \text{say } 1\tfrac{1}{8} \text{ inch,}$$

for thickness of the side rod strap at *g*, Fig. 421.

In the seventy-third paper we have seen and given the reasons that for mogul engines we need two side rods on each side of the engine. For similar reasons we need three side rods on each side of a consolidation engine, namely, the front, central and rear side rods. Figs. 441, 442 represent the front side rod; Figs. 443, 444 represent the central side rod; and Figs. 445, 446 represent the rear side rod for a consolidation engine with cylinders 20 x 24. It will be seen that the central side rod connects two wheels; the straps on this rod have forked ends, to which the front and rear side rods are connected. This manner of connecting side rods differs from the connection of the side rods shown in Figs. 437, 438, in which the rear side rod has the forked end, and the strap around the main crank-pin is forged solid. Again in the front and rear side rods for the consolidation engine, provisions have been made to take up the wear of the bearings in the ends of the front and rear side rods which are connected to the central rod. This makes a very good arrangement; but it must not be understood that this design of side rods is always adopted in consolidation engines, and that the design of side rods shown in Figs. 437, 438 is only suitable for mogul engines. There are many consolidation engines in which the side rods are connected in a manner precisely similar to the method of connecting the side rods in mogul engines as shown in the seventy-third paper.

A Capillary Steam Boiler.

At a recent meeting of the French Society of Civil Engineers, in Paris, M. Serpollet described his new tubular boiler, for which he claims that it cannot possibly explode. The boiler consists simply of a solid drawn steel tube which has, with the exception of its two ends, been rolled out flat, so as to leave in it a channel only 0.1 to 0.3 millimeters wide. The tube is then coiled spirally, and its inner end is bent up vertically to receive the steam pipe, whilst the feed pipe is screwed into the outer end of the spiral. This spiral tube boiler is placed into a furnace which may be of the slow combustion type, and there is no need for either stop valve, blow off cocks, gauge glass, or safety valve. The feed water, upon entering the capillary channel within the tube, is instantly converted into steam, and issues perfectly dry. The inventor claims that, owing to the great velocity with which water and steam must pass through the boiler, there is no possibility of scale accumulating. The tube of a one horse-power boiler is 6′ 6″ long, and, when flattened out, 4″ wide; its total heating surface is about 5 square feet, and it is said to evaporate 45 pounds of water per hour, with a consumption of 9 pounds of coal. The supply of steam to the engine is regulated by regulating the amount of feed water sent into the boiler, and for this purpose the inventor arranges the regulator of the engine either to act upon the waste cock of the feed pump, or upon a sliding block, by which the stroke of the feed pump is altered. There being practically no water in the boiler, the regulation is said to be as precise and quick as with the usual types of engines. To stop the engine it is only necessary to close the cock on the suction pipe of the pump, or open the waste cock fully. A few days after M. Serpollet had brought this boiler before the Société des Ingénieurs Civils, he showed the application of it to a steam-driven tricycle in the streets of Paris. The boiler was carried behind the axle of the main driving wheels, and the engine was fixed under the rider's seat, which also contains a supply of water and fuel. A speed of 6½ miles an hour was attained over roads having 1.5 per cent. grades. The weight of the tricycle in service, but without the rider, is 3¾ cwt.—*Industries.*

In Fig. 5 of Jarno's paper on "Measuring Screws," AMERICAN MACHINIST, Sept. 29, 1888, the distance *c d*, should be .2″ (two-tenths inch) and the diameter of the round piece should be .1″ (one-tenth inch).

The following is from the *Bergen County Democrat:*

Engine 146 on the Erie experimented with Luttgens patent stack on Wednesday. The engine was attached to the milk train and lost 23 minutes' time in the run from Jersey City to Paterson, proving a failure.

In justice to Mr. Luttgens it should be stated that, during an interview with him, he claimed that there is no truth in the statement, and that his stack has not been tried on that division of the road. Before an invention is condemned, investigation into its action should be made, so that, if there is an apparent failure, the cause for such can be determined. In regard to this smoke stack, such results as reported above can happen if the engineer neglects to close the damper in the base of the stack, when it should be closed, and consequently, even if experiments with the stack had been made, as reported, its failure might have been due to carelessness or ignorance on the part of the engineer, and not due to any fault of the invention.

A Shafting Vise.

Our illustrations show a new appliance for use on the bed of a milling machine or planer, to hold shafting while being key-seated; designed by W. S. Rogers, of the firm of Jones & Rogers, mechanical engineers, Cincinnati, Ohio.

The body of the vise is tongued at the bottom, to suit the slot in the table of the milling machine or planer upon which it is to be used.

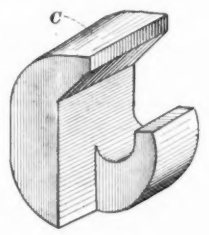
A V is cut lengthwise in the top, in which is placed a V-shaped slide *A*.

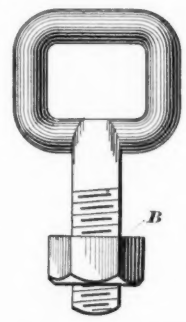
Two steel jaws *C* are yoked together by the eye-bolt *B*, and placed in the recess in the body, at proper distances to prevent springing of the work, which is clamped firmly down into the V-shaped piece by turning the nut on the eye-bolt below, thus drawing the jaws down.

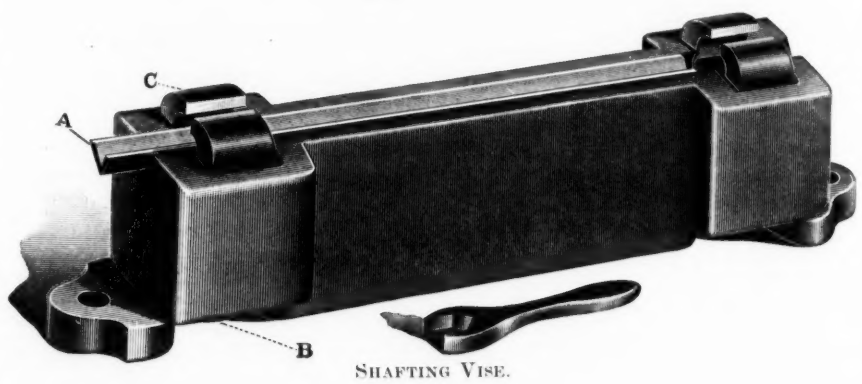
The arrangement is made clear by the detached views, showing one of the jaws and the eye-bolt; one of the latter engaging both jaws of each pair.

Each vise will hold shafting from ⅝″ to 4″ diameter inclusive, and they are made in lengths varying from 12 inches to six feet, jaws being put in at suitable intervals in all cases. It is a vise which will undoubtedly commend itself on account of its strength and simplicity, and because it leaves the top of the shaft uncovered, and nothing in the way to prevent a key-seat being planed or milled the entire length of the shaft, if desired, at one operation, and without changing the position of clamps or other fastenings.

They are manufactured by the firm mentioned above.







SHAFTING VISE.

LETTERS FROM PRACTICAL MEN.

The Importance of Vacuum.

Editor American Machinist:

One of the very best engineers with whom I have been acquainted was a man who had charge of the engines in a large cotton mill. They were old-fashioned engines. One set was made up of a pair of high-pressure horizontal slide valve engines which exhausted their steam into a large pair of old-fashioned beam engines. The other set consisted of a pair of vertical engines exhausting into a very antiquated pair of side lever marine engines made by the firm of Boulton & Watt, and such as were formerly used for paddle steamers. Steam for this old gear was obtained from boilers which only carried 60 pounds' pressure.

The results of such an old-fashioned plant may be supposed to have been but poor, but such was by no means the case, for throughout the year the coal consumption per hour per indicated horse-power was only 2¼ pounds, including the steam used for both warming purpose and for sizing of yarn, there being a large weaving shed attached. The secret of this economical working was, apart from a correct mode of working the steam, the great care exercised to prevent leakage of air into the exhaust pipes and condenser; where a joint was doubtfully tight it was well painted, and all pipes, such as injection, exposed to greater external than internal pressure, were kept well painted. One result of this care was, that after the hours' stoppage at noon, the vacuum gauge on the condenser would indicate 12 pounds. The ordinary working vacuum obtained was 14 pounds, fully—a so nearly perfect vacuum that it is doubtful if it was practicable to improve it, as the mill was by no means down to the sea level. This is equal to 28½ inches by the mercury column, an atmosphere being almost 30 inches. The absolute pressure in the condenser was thus only 1½ inches, roughly. I have heard it argued that such a good "vacuum" is impracticable, but this is not the case, as a little calculation will show, for it has been determined that the temperature of aqueous vapor may be ascertained by the following rule from its pressure *F* in inches of mercury. (Find the sixth root of the number of inches of mercury. Multiply the number thus found by 177 and subtract 100 from the product. The remainder is the temperature of the water, in degrees Fahrenheit, whose vapor has the tension *F* inches of mercury.)

Applying this rule to the question in hand, we require to use a table of logarithms, from which we find that the logarithm of 1½ is 0.17609, and one-sixth of this is 0.02935. The logarithm of 177 is 2.24797. The product of these two logarithms is 2.2773, which is the logarithm of 190 nearly. Then 190°—100° = 90° degrees Fahrenheit, as the temperature of the hot well. That is to say, if there were no air present in the exhaust steam, and no air leaked in through bad joints and pores, a vacuum of 14 pounds would always be obtained, so long as the supply of injection water was sufficient to give a hot well temperature of 90°. This fact gives rise to further reflection, for it shows how important it is that an intelligent engineer should thoroughly understand the connection which exists between the vacuum gauge and the hot well temperature.

A knowledge of mathematics is not requisite, nor the ability to work by logarithms. All that is required is an ordinary table of the properties of steam, such as is found in almost all engineers' pocket books, such as Molesworth's, now before me, in England, or Nystrom's, Haswells, etc., in America. In the table before me I find that a vacuum of $13\frac{7}{10}$ pounds, equivalent to $27\frac{9}{10}$ inches on the mercury column, ought to be obtained with a hot well temperature of 102°.

Now if I examine an engine and find the hot well is only 90°, and the vacuum only $13\frac{7}{10}$ pounds, instead of 14 pounds, I know that the difference is due to the presence of air, and my first step would be to gradually close down the injection valve, keeping my eye on the vacuum gauge, which ought, when in its right place, to be facing the engineer, as he stands at the valve. I should continue to close this valve until the vacuum gauge began to go back, when I should just open up a very little again, and try the hot well temperature. If this were now 100° I should know that the condenser was almost perfect as a condenser, and any further effort would be to improve the action of the air pump; but however high stood the gauge, I should always use the smallest quantity of injection water possible, and consistent with the vacuum.

There are good reasons for this. First, the power required to work the air pump is reduced to a minimum. Secondly, the boiler feed, which is taken from the hot well, is as hot as possible, and so I save fuel. Thirdly, the chilling effect, if any, upon the cylinder, is less. In every engine house having a condensing engine there should be hung up alongside the vacuum gauge a table showing the pressures and temperatures of what I will term "vacuum" steam.

Vacuum in Pounds.	Vacuum in Inches of Mercury.	Absolute Pressure in Inches of Mercury.	Absolute Pressure in Pounds.	Temperature.	Remarks.
8.7	17.71	12.21	6.0	170.2	
9.7	19.74	10.17	5.0	162.3	Poor.
10.7	21.78	8.14	4.0	153.1	Medium.
11.7	23.81	6.10	3.0	141.6	Fair.
12.0	24.43	5.49	2.7	135.0	Ordinary.
12.7	25.85	4.07	2.0	126.3	
13.0	26.46	3.46	1.7	117.0	Good.
13.7	27.89	2.035	1.0	102.1	
14.0	28.50	1.42	0.7	87.0	Excellent.
14.7	29.92	0.00	0.0	77.0	Perfect Vacuum.

Such a table, with its remarks, is really only accurate with the barometer at 30 inches, and, strictly speaking, the perfect vacuum varies with the barometer, and I have seen this fall as low as 27 inches at an elevation of less than 500 feet, so that in such weather no engine could get better than 13 pounds' vacuum. Thus, a barometer should always hang alongside the vacuum gauge. Indeed, the two columns should stand side by side, and rise from the same vessel of mercury.

Whilst on the subject of vacuum, it may be added that, when indicating an engine, the indicator should be placed also upon the condenser, which should have a tap inserted for the purpose. No accuracy is to be expected in a test when the condenser vacuum is taken from the gauge, the boiler pressure from another gauge, and so on. These, of course, should be noted on

each card as taken, but the variation of these different gauges should always be ascertained by taking on one set of cards every particular, and drawing a line for both the boiler pressure and the condenser, with same spring as used for the cylinder, reading the gauges carefully at the time, in order that all readings may be corrected to a uniform standard.

In conclusion, I would just note that one application of tar to a rather long injection pipe improved the vacuum one-half pound in an engine once tested by me. This appears simply due to the stoppage of minute pores in the cast-iron pipes.

W. H. Booth.

An Engineer's Experience.

Editor American Machinist:

I have been reading "An Engineer's Reflections" this morning, and now, sitting here in the engine-room, my mind wanders back over my engineering experience, and I wonder to myself how near I have come to following out the writer's line of thought. Seven years ago I took charge of this plant—a twenty-five horse-power engine. It was in running order then—extravagantly so. The proprietor was an old-fashioned man—believed in practice, not in theory—with no confidence in machine papers or books. He could not understand them, and thought no one else could. There was no damper in the chimney, and he didn't want one. Said if it had been useful the manufacturers would have put it there in the first place. No draft doors to the ash pit, for the same reason. Punch gauges in the boiler head that wouldn't be punched; they had grown together with time, but leaked all the same, and had rusted out one side of the chimney. No water column, but a glass gauge with brasses screwed into a couple of half-inch pipe connections, with the ends next the glass held together with wire. Boiler badly scaled. Bridge wall there was none, but in its place a high bank of ashes, reaching up to within an inch of the boiler and reaching back six feet or more. This ash-pile choked the draft so that the best fires failed to keep steam when the heavy machines were on. The engine was loose all over, and leaking steam at every joint. The cylinder was cut, and rings down, and the engine was covered with oil and dirt. There were no oil cups.

The first cleaning-out day I opened the ash door (made of brick), went under boiler and cleaned out enough of the bridge wall to let the fires burn. I cleaned about $\frac{1}{4}$" of soot off boiler bottom, etc., did the best I could for the inside, and filled up again.

It had been the practice to draw fires and blow out Saturday, before cleaning on the next Monday. This, together with very hard water, had made the thickest lot of scale I ever saw in a boiler. I never blow out now, but it took time to teach the proprietor better. I set the cylinder rings out and started up the next morning with marked improvements in holding steam. Little by little I have improved on the old style, until now the fuel bill is reduced over one-fourth. I do less hard work and get better wages.

The factory has been moved twice. The first time there was a good damper put in the chimney, and the rusty hole caused by leaky gauges patched. A good bridge wall was put under the boiler, and the boiler covered with a non-conductor. In time the cylinder was re-bored, a lubricator put in the steam pipe, oil cups put on the bearings, and an independent feed pump put in. The proprietor comes down once in a while with a smile, and I am happier. Fred.

A Key Gauge.

Editor American Machinist:

When a man has a key to fit he generally (at the expense of considerable time) whittles out a wooden pattern by which the blacksmith forges the key, and oftentimes neither the key nor pattern are correct.

After using the wooden pattern until thoroughly disgusted with it, we made sheet-iron gauges, which gave so much satisfaction that I made an adjustable one.

Take first a piece of steel about an eighth of an inch thick and of the requisite width and length to suit the size of keys to be gauged, and cut three slots in it as large as the largest key you think you will have to make. Then make three small pieces about $\frac{3}{16}$ thick, a little wider than the slots are deep, and of the same length as the spaces between the slots; next cut a slot in each of them, nearly their whole length.

Fasten these pieces to the large piece (as shown in the sketch), with screws, and your gauge is complete.

In using this gauge, first make a wedge of hard wood, and pushing it into the large end of the key-seat lightly, so as not to compress the wood, mark it, and do likewise with the other end and width of the key-seat.

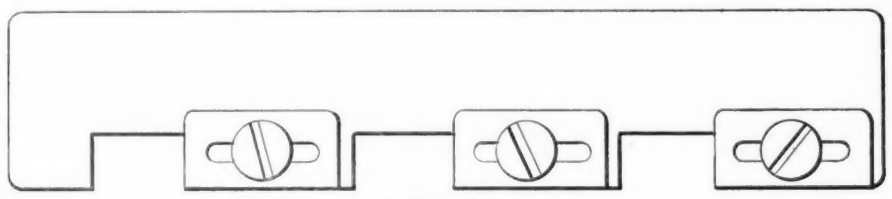
Then set the three slots to the size of the wedge at the marks, allowing about $\frac{1}{32}$ of an inch to grind and file.

I have often had a key forged by this gauge, ground the scale off and then filed it to fit exactly the first trial.

I do not know that the device is new, but at least I can say that if it were more generally used it would result in considerable saving of time, labor, and "cuss words."

Shepperd Mallory.

Charlotte, N. C.



A Key Gauge.

Ninth Annual Meeting of the American Society of Mechanical Engineers.

The next meeting of the American Society of Mechanical Engineers will be held at Scranton, Pa., beginning Oct. 15. The sessions will be held at the hall of the Young Men's Christian Association, and the secretary's headquarters will be at the Westminster Hotel. Members who do not succeed in getting accommodations at the Westminster are advised by the secretary to go to the Wyoming House.

On Monday evening there will be an address by Col. J. A. Price, and the annual address by the president of the society.

On Tuesday, in addition to the regular business, members will visit the electric railways, and the works of the Lackawanna Iron and Steel Company. In the evening an informal reception will be given by the Board of Trade.

Wednesday afternoon members will visit the works of the Dickson Mfg. Co., the Price Brook Colliery and the Boies Steel Works.

Thursday the members will go by special train to Hawley and Honesdale, taking the gravity cars over the Moosic Mountain to Carbondale.

Following is a list of "Topical Discussions" so far presented.

66. What experiences and phenomena can you describe as to the conduct of steels under the conditions in which you were using them?

67. How much allowance is wise in shrinkage fits with steel?

68. What is the best form of cross-section to adopt for steel castings of a complicated nature in order to secure solidity and freedom from shrinkage cracks?

69. How often must the skin of steel be removed in grinding true gauges, etc., before change of form ceases?

70. Is there any recognized method of deciding proper sizes of tap drills for given threads and for different materials? and, if not, would it not be advisable to formulate one based upon the amount of metal corresponding to some fraction of depth of thread to be left in the holes to be operated upon by the tap for each material?

71. What is the best method of preventing variation in pitch of screw threads, as cut by dies in the screw machine, resulting from irregular stretching or flow of the metal, caused by the action of the dies when operating upon large numbers of comparatively long screws of small diameter?

72. Have you used power moulding machines successfully in the foundry?

73. Wherein do the bucket curves of modern turbines differ from those derived from purely theoretical considerations?

74. What limit is there to the speed of caloric or hot air engines?

Original Diameter of Taps and Bolts.

By Pedro.

The question of standard sizes, in machine shop practice, is often an important, and sometimes a very perplexing one. That of standard taps and dies, or bolts and nuts, is one of about as great importance as any standard which has been introduced, and I think it has furnished its share of the perplexities usually attending the establishment and maintenance of standard sizes. That part of the subject which has brought out more discussion and study than any other connected with screw threads is, I think, the problem of how to determine the correct diameter. Various methods of doing this have been discussed, but all, as far as I am aware, possessing some acknowledged imperfection, which it was difficult to overcome. For example, in turning an ordinary "V" thread, it is an easy matter to turn the blank to any desired diameter, but to cut the thread afterwards, so it will just come to a sharp point or edge at that diameter, is not such an easy matter, and is only a guess method at its best. Measuring from point to point on opposite sides has been naturally objected to on account of the line of measurement being oblique to the axis—not at right angles to the axis. Other methods have the same defect. This could be overcome by providing a micrometer with measuring surfaces large enough to cover several threads, but then there would still remain the uncertainty as to whether we were measuring from the sharp "Vs" or from a flattened thread, the flat not being perceptible to the eye. It is comparatively easy to duplicate screw threads by standard plugs and gauges, provided these are correct. The question is, how can we know that the plugs and gauges which we are using are correct? or, in other words, how can we originate a standard thread plug and gauge of any given diameter?

A method of doing this was suggested by a principle often made use of in measuring the distance between the centers of shafts, hubs, bosses, etc., on machinery. This principle is illustrated in Fig. 1. Let A and B be the centers of two shafts, hubs, or in fact any objects whatever, the two being of equal dimensions. On machinery there is never a definite point at the center A or B to measure from, in which case we usually measure from the inner edge of one object to the outer edge of the other, as from D to E or from F to G, each of these distances being equal to the center distance, C. This could be easily proved by supposing the circles A and B to represent two positions of the same object, it having been moved from A to B. In this case the point D has moved to E; A to B; F to G; H to I, and it is evident that every particle in the object must move over an equal space; hence these distances are all equal to each other and to the center distance, C.

When the two objects are not equal, then the center distance C can be obtained by measuring the distance on the inside from F to E, adding to this the outside distance $D\,G$, and dividing by 2; that is

$$C = \frac{F\,E + D\,G}{2}$$

If we suppose the object to be an equilateral triangle, as at $B\,D\,F$, Fig. 2, and suppose this to have been moved from the position $A\,C\,E$, in the direction of the line $A\,B$, then the distance $A\,B$ will be equal to the distance between the centers of the two positions or triangles $A\,C\,E$ and $B\,D\,F$. It will also be equal to the distance d, between the two lines $G\,I$ and $H\,J$ which are drawn through points lying midway between the apex A and the line $C\,E$, and B and $D\,F$.

Referring now to Fig. 3, the same triangles will be recognized at A and B, that at A coinciding with the screw thread, and the one at B with the cut or space between threads. In the ordinary screw thread here represented the points A and B lie directly on opposite sides of the screw, on a line at right angles to the axis. Hence, if K represents a fixed head of a measuring instrument, of which L is a movable slide, provided with a suitable scale, the slide L being at the zero of the scale, when the point B coincides with the point A of the head K, then the distance between the points A and B can be read on the scale at any time, and this will be the distance or diameter d, at the center of the thread, as indicated by the lines $G\,I$ and $H\,J$, Fig. 3. The outside diameter of the screw is obtained by simply adding the depth of thread to the reading of the instrument. The following formulæ, 1 and 2, will give the diameter d at center of thread for any size screw and number of threads n, per inch.

1. For "V" thread, $d = D - \frac{.866}{n}$

2. For U. S. standard thread, $d = D - \frac{.6495}{n}$

For examples see Table III.

The advantage of this principle is apparent from the fact that the measuring points of the instrument have a bearing on sufficiently large surfaces to give them a firm footing, and also the line of measurement lies at right angles to the axis of the screw.

There is a property of the screw, however, which requires a modification of the instrument. That property is represented in Fig. 4, which represents a screw with its thread turned off to half its depth. The direction of the spiral of the thread lies in opposite directions on the opposite sides of the screw, as indicated by the lines $M\,N$ and $O\,P$, Fig. 4, these lines being tangent to the thread spiral on opposite sides. The angle of these lines will vary with the pitch of the screw, and also with the diameter. This fact requires the measuring instrument to be made so that the head K and slide L, Fig. 3, can swivel about the line $A\,B$ until the "Vs" of the instrument fit nicely into the thread. This provision is made and shown in one form of instrument in the micrometer caliper, Fig. 5. The swivel consists of stems A and B, passing through the micrometer screws C and D, with heads E and F, on the inner ends. On the outer ends are nuts with spring washers under them; the washers being splined to the stems, to prevent the nuts from unscrewing while in use. The spring or elasticity of the washers keeps the heads (E and F) firmly against the ends of the screws C and D. The measuring points G and H, shown in detail in Figs. 6 and 7, are dovetailed to the heads F and E. The dovetails are made with a slight taper, so that the measuring points can be readily replaced at any time by another pair. Several sets of these points must be provided, as each pair can be used only for a certain range of pitches, as is shown in Figs. 8 and 9, the same points being used for all pitches lying between P and p. For other pitches another pair of measuring points must be used.

There is a slight mathematical inaccuracy in this system, but it is so small that it will not be appreciable in practice. This inaccuracy lies in the fact that the angle A, of the screw thread, Fig. 9, is always measured in a plane passing through the axis of the screw, while the angle T of the measuring points, Figs. 6 and 7, would have to be measured in a plane at right angles to the thread spiral, as $Q\,R$, Fig. 4, since the points of the instrument will adjust themselves to this position. It is evident that the angle of thread, as measured in the axial plane $V\,U$, Fig. 4, is not the same as that measured in the plane

$Q\,R$, and that this latter angle necessarily varies with the pitch and diameter of the screw, or the normal spiral angle S, Fig. 4. Now, what is the amount of this variation? or in other words, what should the angle T, of the measuring points be? Of course, this angle should be the same (as near as can be) as the angle of the thread measured in the plane $Q\,R$, Fig. 4, normal to the spiral. Let us designate this latter angle by N. This angle can be calculated for any screw thread from the following formula:

$$3.\ \text{Tan}\,(\tfrac{1}{2}\,N) = \frac{\cos.\ S}{2\cos.\ (\tfrac{1}{2}\,A)}$$

In which S is the angle the normal plane makes with the axis—see Fig. 4—and A the angle of the screw thread measured in the axial plane, Fig. 9. This latter angle is 60° for an ordinary "V" thread and the U. S. standard, for which cases the formula reduces to

$$4.\ \text{Tan.}\ (\tfrac{1}{2}\,N) = .57{,}735\ \cos.\ S.$$

The following is the formula from which the angle S may be obtained.

$$5.\ \text{Tan.}\ S = \frac{1}{\pi\,d\,n} = \frac{.3{,}183}{d\,n}$$

In which n is the number of threads per inch and d the diameter of screw at half the depth of thread—see Figs. 3 and 4. The diameter d, at half depth of thread, is here taken, so as to get an average angle for the thread spiral since this varies with the diameter of the cylinder of the helix. Now, taking some of the diameters and pitches of the U. S. standard threads, and calculating the angle by means of formulæ 4 and 5, we obtain Table

TABLE I.

D	n	d	Normal Spiral Angle of Thread, S	Normal Angle of Thread, N
¼	20	.2175	4°, 11′, 7″	59°, 52′, 4″
⅜	16	.3345	3°, 24′, 13″	59°, 54′, 44″
½	13	.4500	3°, 6′, 52″	59°, 55′, 36″
9-16	12	.50825	2°, 59′, 15″	59°, 55′, 56″
¾	10	.685	2°, 39′, 38″	59°, 56′, 48″
1	8	.9185	2°, 28′, 50″	59°, 57′, 12″
1¼	7	1.1575	2°, 14′, 59″	59°, 57′, 42″
1½	6	1.392	2°, 10′, 57″	59°, 57′, 50″
1¾	5	1.620	2°, 15′, 1″	59°, 57′, 42″
2	4½	1.856	2°, 10′, 57″	59°, 57′, 56″
2½	4	2.3375	1°, 57′, 15″	59°, 58′, 16″
3	3½	2.8145	1°, 51′, 3″	59°, 58′, 26″
3½	3¼	3.300	1°, 42′, 0″	59°, 58′, 41″
4	3	3.7835	1°, 36′, 23″	59°, 58′, 50″

TABLE II.

Threads per Inch.	a	c	e	T
20 to 13	.006	.037	.020	59°, 53′, 50″
12 to 7	.010	.065	.030	59°, 56′, 49″

See Figs. 6 and 7.

TABLE III.

Diameter of Screw.	Threads per Inch.	Reading of Instrument.	
		U. S. St'd.	"V" Thread.
¼	20	.2175	.2067
5-16	18	.27625	.2644
⅜	16	.3345	.321
7-16	14	.39075	.37565
½	13	.450	.4334
9-16	12	.50825	.4903
⅝	11	.566	.5463
¾	10	.685	.6634
⅞	9	.803	.7788
1	8	.9185	.8918
1⅛	7	1.0325	1.00128
1¼	7	1.1575	1.12628
1⅜	6	1.2675	1.23067
1½	6	1.392	1.35567
1⅝	5½	1.507	1.46755
1¾	5	1.620	1.5768
1⅞	5	1.745	1.7018
2	4½	1.856	1.8076

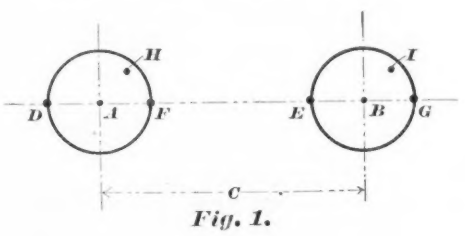


Fig. 1.

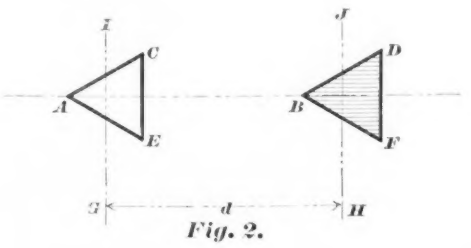


Fig. 2.

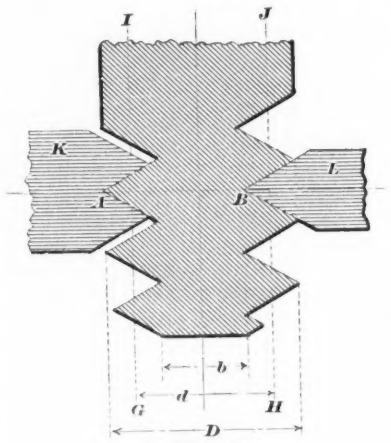


Fig. 3.

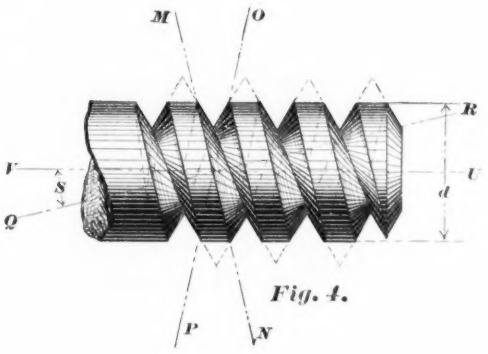


Fig. 4.

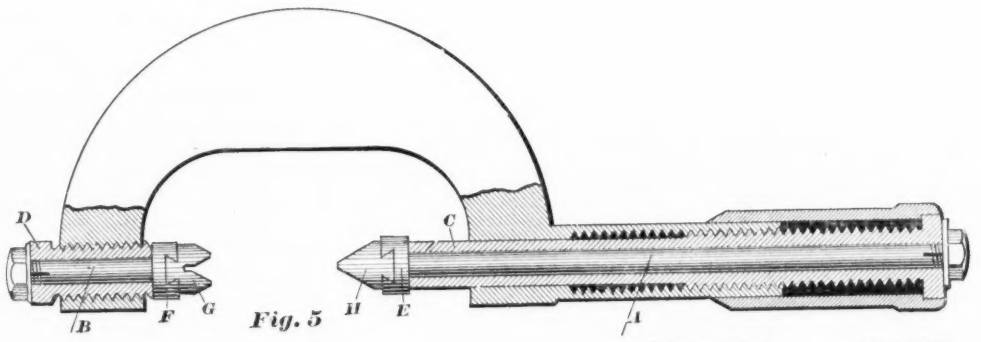


Fig. 5

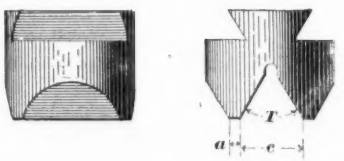


Fig. 6.

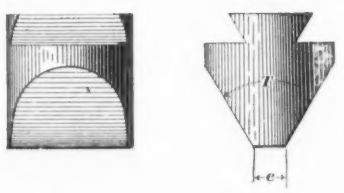


Fig. 7.

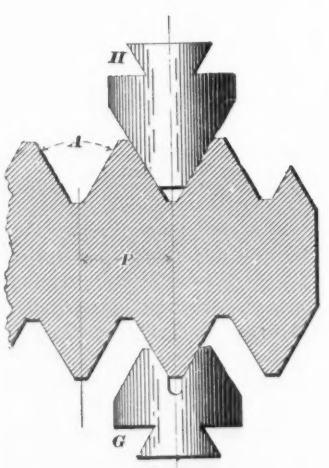


Fig. 9.

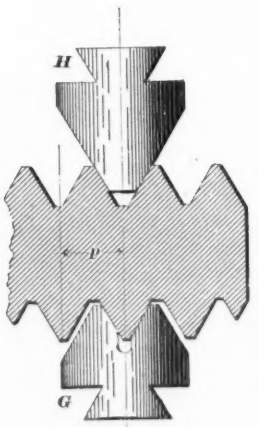


Fig. 8.

ORIGINAL DIAMETER OF TAPS AND BOLTS.

I. This table gives us the normal angle N, of the screw thread, which should also be the angle T, of the measuring points, Figs. 6 and 7. Now let Figs. 8 and 9 represent the finest and coarsest pitches respectively for which the measuring points are used. On the fine pitch, Fig. 8, the measuring point G just clears the bottom of thread, and it is then used on all coarser pitches up to a pitch where the measuring point G reaches about one-half the depth of the thread, as indicated in Fig. 9. The measuring point H has its point flattened off, so it will clear well the bottom of the coarsest thread on which it is used. With this range we can use one set of measuring points for all pitches from 20 to 13. The next pair will range from 12 to 7 threads per inch. Now, taking the mean between the greatest and smallest angles N, from Table I, for these ranges of pitch, we obtain the angle T for the measuring points, Figs. 6 and 7, the dimensions of which are given in Table II. By comparing the angle of the measuring points, Table II, with the actual normal angle of the threads, Table I, we find a maximum difference between 20 and 13 pitch of 0°, 1′, 46″, and between 12 and 7 pitch 0°, 0′, 53″. This difference is evidently too small to be appreciable in practice.

Table III gives the diameters d at the center of thread, or the reading of the micrometer for the different sizes of screws, and is an important accompaniment of the instrument.

In reading the above, the idea will naturally suggest itself to any one, that it would be better to measure the angle of the thread in the plane, normal to it, instead of the axial plane; then the angle of the thread would always fit the measuring points of the micrometer. This could, of course, be done without making any serious change in the axial angle if the normal angle was uniformly made 60°, but it would be too much trouble in ordinary practice to carry out this idea, as the thread tool would have to be ground or set to a different angle for every diameter and pitch. (See Table I.) In a shop where a specialty is made of the business, it could be carried out without much trouble, since special tools are usually provided for the different operations; but such practice would only lead to endless trouble and annoyance in every other shop that should make any attempt to use the product of the former.

In this system of measuring screw threads the measurements are always taken from the sides of the thread—the surfaces which should fit the corresponding surfaces in the nut—and not from the top or bottom of thread. With a positive measurement of this kind a standard plug can be reproduced at any time with precision, without regard to previously existing gauges. The gauges are then easily made to fit the plugs. This leads us to

A DEFECT IN THE U. S. STANDARD THREAD.

The flat portion at the top and bottom of thread being the same in the Franklin Institute or U. S. standard thread, it would require very accurate work to make the threads fit nicely if this standard was strictly adhered to. Suppose we have a perfect tap made to this standard, how long would it remain perfect in use? As soon as the points and corners become worn off a little, the thread of the bolt will bottom, and not fit on the sides—just the thing which should never happen. To overcome this, the threads of bolt and nut should be made with a narrower flat at bottom than at the top of the thread. Making the flat at top of thread one-eighth of the pitch, as in the U. S. Standard, the flat at bottom should not be more than one-sixteenth of the pitch, or one-half the width of the flat at top. This would enable us to always make a snug fit at the sides of the thread, without being annoyed by the thread bottoming. Or taps the flats would have to be reversed, of course, the narrow flat being at the top of thread and the wide one at the bottom. This would make the outside diameter of the tap larger than the bolt, since the central diameters, as measured by the micrometer, Fig. 5, will necessarily have to be the same, as this is really *the standard size*.

"*There is nothing new under the sun.*" Just before putting the above article into the mail, my AMERICAN MACHINIST, of Sept. 22 arrived, in which Jarno startles me with the announcement that the above method of measuring screw threads has been in use two years! Also, that it has been patented! The "fond hopes" of another inventor dashed to pieces; but I have not applied for a patent, nor did I intend to do so.

The *Engineer and Iron Trades' Advertiser* describes a method of removing rust from iron by immersing the articles in a bath consisting of a nearly saturated solution of chloride of tin. The length of time during which the objects are allowed to remain in the bath depends on the thickness of the coating of rust; but in ordinary cases twelve to twenty-four hours is sufficient. The solution ought not to contain a great excess of acid if the iron itself is not to be attacked. On taking them from the bath, the articles are rinsed in water, and afterwards in ammonia. The iron, when thus treated, has the appearance of dull silver; but a simple polishing will give it its normal appearance.

The city of Pittsburgh last week combined with a lengthy jollification over the one-hundreth birthday of Allegheny County a very considerable note of rejoicing over the completion of the three million dollar Court House, without any *steal* in it! So they say. But no Pittsburgher can deny that *steel* had a good deal to do with its erection.

A cable message from the Liverpool Cotton Association announces that cotton baled with cotton sheeting, the new substitute for jute bagging to which we referred last week, will be accepted as a good delivery. Thus an effective blow seems to have been struck at the jute bagging trust.

AMERICAN MACHINIST

To prevent delays all Communications should be addressed to the Company.

PUBLISHED WEEKLY
BY
American Machinist Publishing Co.
96 Fulton Street, New York.

Horace B. Miller, Pres't and Bus. Manager.
Lycurgus B. Moore, Treas. and Sec'y.

F. F. Hemenway, Editor and Mech. Engineer.
J. G. A. Meyer, Fred J. Miller, } Associates.

Special Announcements.

☞ *Positively we will neither publish anything in our reading columns for pay or in consideration of advertising patronage. Those who wish to recommend their wares to our readers can do so as fully as they choose in our advertising columns, but our editorial opinions are not for sale. We give no premiums to secure either subscribers or advertisers.*

☞ *Every correspondent, in order to insure attention, should give his full name and address, not for publication, but as a guarantee of good faith.*

☞ *We are not engaged in procuring patent rights, or in selling machinery, nor have we any pet scheme to advance, or hobby to ride.*

☞ *We invite correspondence from practical machinists, engineers, inventors, draftsmen, and all those specially interested in the occupations we represent, on subjects pertaining to machinery.*

☞ *Subscribers can have the mailing address of their paper changed as often as they desire. Send both old and new addresses. Those who fail to receive their papers promptly will please notify us at once.*

Subscription.

$2.50 a year in advance, postage prepaid in the United States, Canada and Mexico.
$3.50 a year to Other Countries, postage prepaid.

Advertising.

Transient, 35c. per line, each insertion.
"Business Specials," 50c. a line.

The American News Company,
Publishers' Agents, New York.
The International News Company,
11 Bouverie Street, Fleet Street, London, Eng., will receive subscriptions for the American Machinist, at 14/7 per annum, postage paid.

DEALERS SUPPLIED BY

The Albany News Company, Albany, N. Y.
The American News Company, New York, N. Y.
The Baltimore News Company, Baltimore, Md.
The Brooklyn News Company, Brooklyn, N. Y.
The Central News Company, Philadelphia, Pa.
The Cincinnati News Company, Cincinnati, Ohio.
The Cleveland News Company, Cleveland, Ohio.
The Colorado News Company, Denver, Colorado.
The Detroit News Company, Detroit, Mich.
The International News Company, New York, N. Y.
The Minnesota News Company, St. Paul, Minn.
The Montreal News Company, Montreal, Canada.
The National News Company, New York, N. Y.
The Newark News Company, Newark, N. J.
The New England News Company, Boston, Mass.
The New Orleans News Company, New Orleans, La.
The New York News Company, New York, N. Y.
The Northern News Company, Troy, N. Y.
The Omaha News Company, Omaha, Neb.
The Pittsburgh News Company, Pittsburgh, Pa.
The Rhode Island News Company, Providence, R.I.
The San Francisco News Co., San Francisco, Cal.
The South West News Company, Kansas City, Mo.
The St. Louis News Company, St. Louis, Mo.
The Toronto News Co., Toronto, Ontario, Canada.
The Toronto News Co., Clifton, Ontario, Canada.
The Union News Company, New York, N. Y.
The Washington News Company, Washington, D. C.
The Western News Company, Chicago, Ill.
The Williamsburgh News Co., Brooklyn, E. D., N. Y.

NEW YORK, OCTOBER 13, 1888.

CONTENTS.

	PAGE.
New Oscillating Engine	1
Spacing Table	1
Shop Notes	2, 3
A Machinist's Sermon. By Jarno	3
Modern Locomotive Construction. By J. G. A. Meyer	4
A Capillary Steam Boiler	5
A Shafting Vise	5
Letters from Practical Men: The Importance of Vacuum. By W. H. Booth—An Engineer's Experience. By Fred—A Key Gauge. By Shepperd Mallory	5, 6
Ninth Annual Meeting of the American Society of Mechanical Engineers	6
Original Diameter of Taps and Bolts	6, 7
Smothered Inventions	8
English and American Machine Tools	8
Literary Notes	8
Questions and Answers	8, 9
Manufactures	9
Machinists' Supplies and Iron	10

Smothered Inventions.

The result, and in fact the object of the patent laws, is to give to the inventor for a certain number of years the exclusive right to manufacture and sell, or, in other words, a monopoly of that which by his mental labor he has created. Brain work is as truly labor as is muscular exertion, and no one but a Socialist would say that the community ought to take for its own benefit that which is the result of individual labor, mental or physical, without full compensation.

But, upon the other hand, it is plain that the inventor has no right to expect the government to protect him in the enjoyment of his monopoly without receiving something in return.

A patent is, in reality, a contract by which the people (represented by their government) agree that they will not make use of the specified invention for the term of seventeen years from the date of the patent, except upon such terms as may be agreed to by the inventor. This would seem, when carried to its logical conclusion, to involve the right of the inventor to impose such terms for the use of his invention as to practically lock it up and prevent its use during the term of the patent, whenever it seemed to him that his interests required it. But all contracts are supposed to confer benefits of some kind upon both or all the parties to them; and, it is a well settled principle of law, that a contract without consideration is void.

The people of the United States, in granting to an inventor a patent upon his invention, collectively agree to prevent, by the whole power of the government, any one or more of their number from using the specified device, except with the consent of the inventor, even to the extent of preventing a second honest inventor from making personal use of it; the power of the courts being guaranteed to compel the payment to the patentee by the infringer—innocent though he may be—the full value of his use of the patented device, to enjoin him from further use of it, and to enforce that prohibition, upon penalty of imprisonment if necessary. In short, to use all the means required to secure to the inventor an absolute monopoly of the subject of the patent for the specified term.

We believe it is just and right for the people to make such contracts, binding themselves to do these things, provided the people receive a corresponding benefit as a result of the contracts. It is held that this benefit comes to the people in the incentive given for the production of inventions, by the use of which the interests of the community are advanced. The benefits to the people, arising from the use of new inventions and improvements, the invention of which is stimulated by the security given by patents, is acknowledged to be the only justification for the bestowal upon individuals of such privileges as are granted by them, and it is this benefit which constitutes the "value received," in return for which the people bind themselves to perform their part of the contract.

When a new invention is brought into use, in competition with the previously used means for accomplishing the same end, it is *prima facie* evidence that the community has received some benefit from the contract entered into with the inventor, else the old methods would continue to be used; for no new devices or methods will be adopted unless they are thought to be in some way better than their predecessors, and when new inventions fail to come into use because they are not superior to the old, then no exercise of the governmental authority for the protection of the patentee will be needed or called for, and the only loss will fall upon the inventor. But it is to be noted that it is only by the practical use of the inventions patented that the people can possibly receive any benefit from them.

If an invention be valuable, some one will want to use it, and the agreement of the government to protect the patentee in the use of it becomes valuable; but if the inventor, or the person to whom he assigns the patent, refuses either to use it himself or to allow others to do so, then it becomes pertinent to inquire what benefit the people derive from the contract into which they have entered. And if it appears that they derive no benefit from it, then it becomes pertinent to inquire further, by what rule of law or justice the people are bound to the fulfillment of their part of the contract.

It is well known that many useful inventions are patented and sold to large corporations, who buy them for the sole purpose of preventing others, and possible competitors, from using them. The Bell Telephone Co. is said to own patents which, if they were used, would not only lessen the cost of the instruments, but very much improve the telephone service. They do not use them, simply because they have a monopoly of the telephone business, and need to look only to the matter of dividends, without any regard to the interests of the people who protect them in their monopoly.

The Western Union Telegraph Co. is said to pay a certain electrical inventor a regular retainer for the privilege of the first examination of his patentable inventions, with a view to their purchase; and that the company owns a great many inventions, which, if put into use, would greatly improve the telegraphs and lessen the cost of operating them.

These inventions are not used, simply because, with the present instruments and by the present methods, the dividends of the company are so large as to be almost unwieldy, and require constant "watering" to keep them anywhere within the bounds of reason or safety. We think it would be very difficult to show in what way the people are benefited by these inventions, and if they are not benefited by them, why should they protect them? If the owner of a patent will neither use it himself nor allow others to use it upon any terms, does he not thereby entirely prevent the people from deriving that benefit from their patent contract with him which alone makes that contract binding upon them? and have they not the right to declare the contract void? It is useless to set up the claim that the people derive their benefit from the throwing open of the invention to public use at the end of seventeen years, because in these days advancement is so rapid that comparatively few patents are intrinsically worth much at the end of that time, having usually been superseded by something better, unless the later improvements have been locked up in the manner indicated. This matter, to which we have called the attention of our readers, is one which should receive consideration. The people are undoubtedly being defrauded of their rights in this way, and some of the remedies which we think will bear considering are the assumption by the government of all those enterprises in the service of the people, which are in their nature monopolistic, and the full recognition of the fact that the community, by its action in protecting inventions, gives to them their value as monopolies, and should, in justice to itself, see that it is made possible for the people to derive some benefit from them, and upon reasonable terms.

Of course we believe that the owner of a patent should be protected in the full enjoyment of all his rights, but it should also be remembered that the public have rights which should receive some consideration, and that both parties to a contract have a right to the chance of deriving benefits from that contract, even though one of the parties be the long-suffering public.

English and American Machine Tools.

An American machine tool manufacturer has just returned from a trip to Europe, where he says he did a great deal of pure loafing, but not apparently without an eye to business. He finds a great difference in machine tool processes in England, as compared with this country. He looked through a number of establishments, and nowhere saw a quick-return arrangement on any planer or slotter, and hardly anywhere did he observe cut gears in use on machine tools. Other differences were noticeable, proving to his mind that an equal number of workmen operating American-made tools logically *ought* to do more work in a day than the same number of men operating English-made tools. He says an English concern had just got in about $10,000 worth of machine tools, built by an American manufacturer, and took considerable pleasure in showing them off to a prominent English builder, with the pleasant suggestion that *there* were some tools worth copying! Modesty forbids his mentioning the name of the American builders.

Literary Notes.

POOR'S MANUAL OF RAILROADS, 1888. Twenty-First Annual Number. H. V. & H. W. Poor, New York.

This work stands alone as the only publication of the kind, and is looked for with interest each year by those interested in railroad matters. It is compiled with great care, and contains the history of all railroads in the United States, Canada and Mexico, together with any information in regard to their operation that is likely to be desired. It is a standard work, cheap at the price, which is $5.00.

We have received from the publisher, Roderick H. Smith, author of *The Science of Business*, etc., a *Business Chart*, "showing the course of business in the United States for the last thirty years." The chart is 42x19 inches, divided vertically and horizontally by parallel lines. Traversing it are broad lines of various colors, by which one can tell at a glance the average yearly price of pig-iron per ton; average of failures among traders; number of immigrants each year; average price of railroad stocks; clearings of the New York banks; miles of railroad built each year; exports and imports for each year; and the shares of stock sold each year. The chart affords a ready means of comparing the figures of any year with those of any other year, and also for comparing the upward and downward movements in volume and prices in any line with those of any other line. The authority for the values given is cited in each case, and they are of such a character as ensures their reliability. The chart is a very useful and interesting one, and ought to be well received by every one interested in tracing the course of business.

Among the partial list of subscribers given in a circular accompanying it, we notice the names of several leading manufacturing companies, and it is the intention, if this one is well received, to issue a similar chart about February of each year, bringing the statistics down to the year in which the chart is printed.

The publisher is Roderick H. Smith, 25 Whitehall street, New York.

Questions and Answers.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly, and according to common-sense methods.

Every question, to insure any attention, must invariably be accompanied by the writer's name and address. If so requested, neither name, correct initials nor location will be published.

(444) J. G., Westchester, N. Y., asks: Kindly inform me if there is any way in which cold cast-steel can be sawed? If so, what kind of a saw is used? If it cannot be sawed when cold with advantage, what kind of a saw is used to cut it while hot? *A.*—For cutting cast-steel either hot or cold, a circular saw running at high speed can be used; but whether it will be advantageous to do so when the steel is cold, will depend on the quality of the steel.

(445) E. H. I., Carthage, Mo., writes: We frequently have hard pulleys to bore and turn and they are "death on tools." Mushet steel won't stand an edge, neither will Black Diamond. Can you suggest something that will help us? *A.*—The best thing we can suggest is to avoid having anything to do with hard pulleys. If we had a lot of pulleys as hard as those you speak of, we should run them through the cupola, mixing with them enough other iron of the proper grade to make them soft. But if you must work them, then the best plan is to reduce the cutting speed until the best obtainable tools will stand. The solution you speak of sometimes works well where hard steel is to be worked, especially with the drill, but would be no help in your case.

(446) Gas, ———, writes: If a cylinder 24 inches diameter and 20 feet long is pumped full of gas to an absolute pressure of 500 pounds per square inch, into how many cubic feet will the gas expand if liberated to a pressure of 2½ inch height of water column. The pressure of a 2½ inch water column is to be taken at .09042 pounds. *A.*—The cross-sectional area of the cylinder is equal to 3.1416 square feet; hence it will contain $3.1416 \times 20 = 62.8320$ cubic feet of gas at an absolute pressure of 500 pounds per square inch Expanding this gas to the required pressure, and leaving the temperature out of the question, we have first: the absolute pressure to which the gas is to be expanded is the sum of the pressure due to the 2½ inch column of water and the pressure of the atmosphere, hence the final absolute pressure is $.09042 + 14.7 = 14.79042$ pounds. Consequently the gas will expand to

$$\frac{500 \times 62.8320}{14.79042} = 2124.07 \text{ cubic feet.}$$

(447) M. J., New York, writes: I have just completed a steam engine of 1-30th of a horse-power. I now need a boiler, and I want to make it out of brass. Would you kindly tell me how large a boiler it requires, and if I need a safety valve on it? also does it need a steam gauge? *A.*—We should recommend a small horizontal boiler, fired internally and made in the following manner: For the outside shell use a tube 7 inches diameter, 14 inches long, with flat heads riveted to each end. For the fire-box use a tube 3 inches inside diameter running through the heads and riveted to the same. This small tube should be placed near the bottom of the outer shell, so as to leave about 1 inch clearance or water space between the two. Run stay bolts from head to head. Also place a wash-out plug at each end of the boiler in a convenient position, as close to the bottom of the boiler as possible. At one end of the small tube make arrangements for the fuel, at the other end attach a suitable uptake. Also attach safety valve, steam gauge and gauge cocks. The thickness of the tubes and heads will depend on the steam pressure you intend to carry.

(448) Leverage, ———, sends us a sketch of a system of levers which may be described as follows: A lever *A B* turns on a fixed fulcrum *C;* the length of the short lever arm *A C* is 5 inches, and that of the long lever arm *A B* is 70 inches. The lever is of uniform cross-section and weighs 90 pounds. At a given distance below this lever, another fulcrum *E* is given, around which a second lever *F D* turns; its short lever arm *E F* is 4 inches, its long lever arm is 40 inches, its center of gravity *M* is 15 inches from the fulcrum *E;* this lever weighs 10 pounds. Both levers *A B* and *F D* work in the same plane, and the lower lever *F D* is so placed as to make its extremity *D* touch the long lever in a point 50 inches from the fulcrum *C*, when the long lever *A B* is in a horizontal position. The purpose of the second lever *F D* is, that a weight placed at the extremity *F* of the short lever arm *E F* shall balance a weight *G* of 60 pounds applied to the long lever arm *C B* of the lever *A B;* this weight is placed 55 inches from the fulcrum *C*. It is now required to find the weight placed at the extremity *F* of the lower lever to balance the weight *G* placed on the lever *A B;* weights of levers to be taken into consideration. *A.*—According to the conditions given, the weight of the lever *A B* and also the weight *G* of 60 pounds applied to the same must be balanced by the extremity *D* of the lever *F D;* this point or extremity *D* is 50 inches from the fulcrum *C*. Let us now reduce the problem to a simple one, pay no attention to the second lever *F D*, and treat the lever *A B* as a lever of the third class, or kind in which the power is applied at *D* between the fulcrum *C* and a given weight applied to the lever. The weight applied to the lever is made up of the weight of the lever and the given weight *G*. Let us first determine the force required at *D* to balance the weight of the lever. Since the lever *A B* is of uniform section throughout, its center of gravity must be midway between the extremities *A* and *B*, and therefore will be 32.5 inches from the fulcrum *C*. The distance between the fulcrum *C* and the point *D*, that is, the point of application of the power, is 50 inches; the weight of the lever is 90 pounds, hence the force required at *D* to balance the weight of the lever will be equal to

$$\frac{32.5 \times 90}{50} = 58.5 \text{ pounds.}$$

Our next step will be to find the force required at *D* to balance the given weight *G*. This weight is equal to 60 pounds, and is placed 55 inches from the fulcrum *C*, hence the force required at *D* to balance the weight of 60 pounds will be equal to

$$\frac{60 \times 55}{50} = 66 \text{ pounds.}$$

Consequently the total force at *D* required to balance the weight of the lever *A B* and the given weight will be equal to

$$58.5 + 66 = 124.5 \text{ pounds.}$$

We are now in a position to take the second lever *F D* into account. This lever is a lever of the first class. According to the given conditions, a weight applied to the extremity *F*, which is 4 inches from the fulcrum *E*, must balance a weight of 124.5 pounds applied to the extremity *D*, 40 inches from the fulcrum *E*, and also the weight of the lever *F D*. Let us first find the weight required at *F* to balance the weight of the lever *F D*. The distance of the center of gravity of the lever *F D* has been given, and is fifteen inches from the fulcrum *E*, the weight of the lever is 10 pounds, hence the weight at *F* required to balance the lever is equal to

$$\frac{10 \times 15}{4} = 37.5 \text{ pounds.}$$

The weight at *F* required to balance 124.5 pounds applied at the extremity *D* will be equal to

$$\frac{124.5 \times 40}{4} = 1{,}245 \text{ pounds.}$$

And lastly, the total weight at *F* required to balance the system of levers will be equal to

$$1{,}245 + 37\ 5 = 1{,}282\ 5 \text{ pounds.}$$

This weight applied at *F* will only balance the system of levers when the lever *A B* is in a horizontal position; in any other position the system is not balanced, because the distance between the fulcrum *C* and the point *D* will be changed. 2. If, in addition to the lever *A B*, a weight of 100 pounds is placed on the fulcrum *C*, can I neglect this weight in the calculations? *A.*—If the system of levers is to be extremely well balanced, the friction arising from the weight of 100 pounds placed on the fulcrum *C* must be taken into account.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Wednesday for the ensuing week's issue.

See Grant's Gear advt. on back page.

Link-Belting.
Send for Catalogue of Link-Belting.
Over 50,000,000 feet of Link-Belt in use.
Link-Belt Machinery Co., Chicago and N. Y.

Small Electric Arc Light Plants.
3, 5 and 10 arc lights and up,
Waterhouse Electric & M'f'g Co., Hartford, Ct.

See our new designed engine lathes in Cincinnati Centennial Exposition, Lodge, Davis & Co.

See our new designed drill presses in Cincinnati Centennial Exposition, Lodge, Davis & Co.

See our new designed shapers in Cincinnati Centennial Exposition, Lodge, Davis & Co.

See our new designed brass working tools in Cincinnati Centennial Exposition, Lodge, Davis & Co.

2 000 feet of space in Cincinnati Centennial Exposition, Lodge, Davis & Co.

See special adv't, page 16, Lodge, Davis & Co.

Shafting Straighteners. J. H. Wells, Tampa, Fla.

Steel Name Stamps, etc. J. B. Roney, Lynn, Mass.

Lamb Knitting Machine Co., Chicopee Falls, Mass.

Machine work and pattern making. Anderson Machine Works. Peekskill, N. Y.

Drop presses, punches and shears. Williams, White & Co., Moline, Ill., manufacturers.

The Best Upright Hammers run by belt are made by W. P. Duncan & Co., Bellefonte, Pa.

R. Dudgeon, 24 Columbia st., New York, Improved Hydraulic Jacks and Roller Tube Expanders.

Pattern and Brand Letters. Vanderburgh, Wells & Co., cor. Fulton and Dutch sts., New York.

"Swift" Sight Feed Lubricator; no glass tubes; simple, reliable. Swift Lub'r Co., Elmira, N. Y.

Davis Key-Seating Machines, kept in stock by Manning, Maxwell & Moore, 111 Liberty st., N. Y.

"How to Keep Boilers Clean." A book mailed free by James E. Hotchkiss, 120 Liberty st., N. Y.

"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.

Drawings, mach. patterns and models. Inventors' ideas perfected. Valentine, 15 Alling st, Newark, N.J.

Selden Packing, for stuffing-box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N.Y.

Brown & Sharpe Mfg. Co. have a line of machinery with S. A. Smith, 23 S. Canal st., Chicago, Ill.

Mechanical drawing, calculations, etc., taught by correspondence. I. Donald Boyer, Dayton, Ohio.

Patents—Whittlesey & Wright, 705 8th st., N. W. Washington, D. C. Send for pamphlet and references.

Ice and Refrigerating Machines, 124 built, and all successful. David Boyle, 521 Monroe st., Chicago, Ill.

For the latest improved Diamond Prospecting Drill, address the M. C. Bullock Mfg. Co., 138 Jackson st., Chicago, Ill.

Engine lathes, hand lathes, fine tools, files and supplies for machinists and other metal workers. Frasse & Co., 92 Park Row, N. Y.

Most sensitive and durable Damper Regulator made; works within one pound; send for circular. T. Kieley, 11 W. 13th st., New York.

Upright drills, improved, sizes 21″, 23″, 25″, 28″, 32″, 36″ swing; finely made and great capacity. Currier & Snyder, Worcester, Mass.

Split Pulleys at low prices and of same strength and appearance as Whole Pulleys. Yocum & Son's Shafting Works, Drinker st., Philadelphia, Pa.

R. G. DuBois, solicitor, counselor and expert in patent cases, 916 "F" st., Washington, D. C. Corresp. solicited; highest ref's.; send for pamphlet.

Engine lathe for sale (new), 52-inch swing, screw cutting, power cross feed, compound rest; price low. Salem Foundry & Machine Shop, Salem, Mass.

Machinists' supplies, brass goods, m'f'rs supplies, polishing materials, all kinds wire, metals, etc., in any quantity. Jordan & Gottfried, 208 Canal st., N.Y.

Fine tools and supplies for machinists and other metalworkers. Get our prices before purchasing elsewhere. Montgomery & Co., 105 Fulton st., N. Y. City.

Curtis Pressure Regulators. Curtis Return Trap. Curtis Damper Regulator. See Oct. 6, p. 15. Send for circular No. 17. Curtis Reg. Co., Boston, Mass.

The Holly Manufacturing Company, of Lockport, N. Y., will send, on application, their pamphlet illustrating pumping machinery and reports of duty trials.

W. H. Hoffman, consulting engineer, 108 Liberty st., room 3, N. Y. Mechanical engineering in all its branches; working drawings for the transmission of power by steam, water, air and electricity.

Contract work of all kinds executed promptly and on reasonable terms. Parties wishing gray iron castings in large quantities can make money by corresponding with Rawson Mfg Co., Hornellsville, N.Y.

A system of easy lettering by J. H. Cromwell, giving 26 forms of alphabets. The space to be lettered being divided into squares; simple and effective. Price 50 cents. Catalogue of books for engineers free. E. & F. N. Spon, 12 Cortlandt st., N.Y.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator, and making all required calculations from the diagram; also the principles of economy in operating steam engines, and current practice in testing engines and boilers. Price $2, postpaid. Published by John Wiley & Sons, 15 Astor Place, New York.

The series of articles by J. G. A. Meyer, on "Practical Drawing," now running in the AMERICAN MACHINIST, should be closely followed by every student. They commenced with October 23, 1886 issue, and up to and including Sept. 22, 1888 issue, 59 articles have been so far published. Copies containing these articles, sent by mail to any part of this country or Canada at 5 cents each. AMERICAN MACHINIST PUBLISHING CO., 96 Fulton st., New York.

"Modern Locomotive Construction," by J. G. A. Meyer. The above series of articles, now running in the AMERICAN MACHINIST, are attracting the attention of railway mechanics all over the world. Commencing with the June 27, 1885 issue, 73 articles have thus far appeared up to and including the Sept. 15, 1888 issue. Copies containing these articles sent by mail to any part of the U. S. or Canada at 5 cents each. AMERICAN MACHINIST PUBLISHING CO., 96 Fulton st., New York

MANUFACTURES

It is said that another large cotton factory is to be built at New Bedford, Mass.

The Walla Walla Paper Mill Company is building a mill at Walla Walla, W. T.

A stock company has been organized, to build a cotton factory at Hampton, Ga.

The Chase Turbine Company have nearly completed a new foundry at Orange, Mass.

The Wier Plow Company, Monmouth, Ill., have built an addition to their foundry, 90 x 116 feet.

A company to be known as the Bethlehem Steam Heating Company has been chartered at Bethlehem, Pa.

James McNeil & Bro. have expended $20,000 in improvements on their boiler works at Pittsburgh, Pa.

Twenty thousand dollars have been raised, with which to start a bicycle manufactory at Westboro, Mass.

The Webber Rubber Manufacturing Company, Budson, Mass., are building a factory two stories high, 36 x 50 feet.

A rubber factory is to be built at Beverly, Mass. It will be 60 x 140 feet, and will be built under the auspices of the Board of Trade.

The Haile & Frost Woolen Mills, Hinsdale, N. H., which have been shut down for general repairs, have now started up, with plenty of work.

Frost & Sons, of Paterson, have their branch silk mill at Altoona, Pa., nearly ready for the machinery. It is of brick, two stories high, 50 by 150 feet.

The Minnesota Car Company, of Duluth, Minn., has been organized, with a capital of $400,000. The works will consist of a rolling mill, machine shop, foundry and car works.

Decker & Atkins will soon begin the erection of iron mills, a bolt and nut factory, and a large foundry, near Charleston, W. Va. By spring the works will be in full blast.

The State Farmers Alliance, of Alliance, Tex., have formed a company to put up mills at Dallas, Texas, to manufacture cotton bagging and cotton-seed oil. Capital, $250,000.

The Altoona Car Works, Limited, Altoona, Pa., who do not build cars, but do build engines, are about to set up a boiler shop and to largely increase their machine shop facilities.

Hill Brothers are building a $10,000 mill at Harmony, Maine. They will work up the hard wood in that section of the country into various kinds of turned goods, furniture and flooring.

The Boston Board of Aldermen has granted the West End Street Railway Company, which controls the entire street railway system of the city, the right to use electricity as a motive power.

We have received from B. F. Sturtevant, Boston, Mass., a catalogue of automatic engines built at his works. The catalogue is well illustrated and printed, and has tables of sizes, speeds, etc.

The Stratton Separator Company, 32 Cortlandt street, New York, have issued a pamphlet entitled Dry Steam the Foundation of Economy. In addition to illustrating and describing their separator, the pamphlet contains information of value.

The Palmer Manufacturing Company will erect an additional building, 120 x 40 feet, at their cooperage works, Charleston, S. C., increasing their capacity about 50 per cent. They also contemplate erecting large works at some point in central Georgia.

The incorporators of the Globe Foundry at Wellston, Ohio, have purchased the foundry building recently erected by Spellacy Brothers, and will at once equip and start it in operation, to manufacture miners' supplies, such as cars, tools, etc., and make engines, machinery, etc.

The Norton Emery Wheel Company, Worcester, Mass., have issued a very complete catalogue of emery wheels and emery goods. It contains table of speeds and other information of value. The catalogue is well illustrated, and printed on good paper. Sent free on application.

It is said that the Erie Railway Company have purchased 75 acres of land at Susquehanna, Pa., and that amongst other buildings they will erect a large foundry. The company will also enlarge their machine shop and other shops, and will employ double the number of men at present employed.

The Korting Gas Engine Company, of 60 Barclay street, New York, have taken part of the seven-story Dietz building, corner of Laight and Greenwich streets, New York, for the manufacture of all sizes of their gas engines, and now have facilities for turning out an engine a day. Their office will be removed to No. 431 Greenwich street, in the new building.

B. W. Payne & Sons, Elmira, N. Y., have issued an illustrated catalogue of their new high-speed Corliss engines. The details of the engine are very fully illustrated and described. The catalogue contains matter relating to the selection of an engine and other things pertinent to operating; also a table of powers, speeds and dimensions, also of horse-power under varying speeds and pressures. The New York office of the company is at 45 Dey street.

Efforts are being made to start up the works of the Cartwright Iron and Steel Company, at Steubenville, Ohio. The company made an assignment a short time since. Some of the heaviest creditors now propose that the company give long time notes for 40 per cent. of the indebtedness in full satisfaction of the same, the notes to bear 6 per cent. interest. Then the company will spend $10,000 in making betterments to the plant and resume operations.

The yearly output of Howe, Brown & Co., steel manufacturers, of Pittsburgh, Pa., is 14,000 tons, about one-fourth of which quantity is of the finer steels used in the manufacture of axes, mowing machine knives and small tools. This firm put on the market a year or so ago, a brand of tool steel, called "Cameron Self-Hardening Steel," which we have heard highly commended by prominent American mechanics who have used it, as being in every way equal to the imported mushet.

Wichita Falls, Texas, having been mentioned as possibly a good place for the paper mill that the Texas Press Association are interested in having built somewhere in Texas, a meeting of the citizens was called, at which it was stated that the members of the association would subscribe stock to the extent of $50,000 or $60,000. Then John A. Foreman, J. S. Mayfield, and W. T. Coffield were appointed a committee to further the matter, with the understanding that the citizens would back them liberally.

The Beckett Foundry and Machine Company, Arlington, N. J., have succeeded the Beckett & McDowell M'f'g Co. The works, both foundry and machine shop, have been increased, and new tools added, so as to double their former capacity. The company now have facilities for handling the heaviest kind of work, and in addition to the regular lines of work are prepared for doing anything offered in the foundry and machine shop line. They expect soon to begin the manufacture of Corliss engines.

Among the new factories being put up in the South is one under construction, known as the Eufaula Cotton Mills, at Eufaula, Ala. It is to contain about 8,000 spindles and 240 looms. The machinery is being constructed by the Lowell Machine Shop, of Lowell, Mass., well known all over the country for the standard qualities of its work. The Page Belting Company, of Concord, N. H., have a contract for belting this new mill. This company has lately received several large orders for belting mills complete.

The United States Metallic Packing Company established a branch of their works at 4 Gray street, Glasgow, Scotland, in July last, to take orders for and apply packings made by the company at their Philadelphia works. The enterprise is proving very successful, and it is thought will result in the establishment of complete works in Glasgow at an early day. The steamers City of New York and City of Paris have their main engines fully equipped with twenty packings each. Among others, orders are now in hand on packings for Thompson Bros. and Laird Bros., Glasgow. The Philadelphia works of this company have just been enlarged about one-third. Considerable new machinery is being added.

There was an interesting exhibition of the Tripp anti-friction journal roller bearing at the Bartlett street shop of the West End Street Railway Company, Boston, on Wednesday. One year ago a car of the Consolidated road was equipped with this bearing, and has been in constant use ever since, covering about one hundred miles a day. During this time the bearings have not been touched or oiled, and there was consequently great curiosity among those interested in the journal, and the railway people, in the taking of one of the bearings from under the car. It was found in perfect condition, and showed but the slightest possible wear in a few parts and none at all in most. The Tripp Company had warranted the bearing for a year, but it was evident that it would have run much longer than that without attention, and that its life without oiling would be practically the same as the life of the wheel, or from two to three years. The bearing is constructed on an entirely new principle, by which the axes of the rolls are always kept in line with the axis of the shaft. The company claim that recent tests demonstrate a saving of from 30 to 70 per cent. over ordinary journals. The journal boxes are dust-proof, and one lubrication answers for a year's service.—*Commercial Bulletin.*

Machinists' Supplies and Iron.

New York, Sept. 27, 1888.

Iron—American Pig—The condition of the market is much the same as per our last report. There has been a moderate demand for all grades, contract deliveries absorbing a large proportion of the current output. Manufacturers seem unwilling to contract for more iron than they absolutely require. We quote Standard Lehigh brands at $18 to $18 50 for No. 1 X Foundry; No. 2 X Foundry $17 to $17.50, and Grey Forge, $15.50 to $16.25.

Scotch Pig—The demand continues to be light, but prices are firmly held. We quote Coltness, $22; Gartsherrie, $21; Summerlee, $20; Eglinton, $19.25 to $19.50; Dalmellington, $20.25 to $20.50; Clyde, $20.50, and Langloan, $20.50.

Copper—Consumers are supplied at 16½ cents. Futures are higher, but exhibit little activity.

Antimony—The demand for Regulus has been moderate; Hallett's is held at 10½c. cash; Cookson's, 13c.

Lead—The market rules quiet, speculative trading being light and consumers showing no disposition to enter the market except to supply immediate and absolute wants. Values are held at 5c. to 5⅛c. cash

✻WANTED✻

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Wednesday morning for the ensuing week's issue.

Wanted—Men to examine S. S. planes; see p. 11.

Mech'l draftsman and designer, has had practical shop exp., wants position. Box 20, Am. Machinist.

Draftsman having twelve years' experience in tool and general machine work, desires position; references. Box 26, American Machinist.

Wanted—Travelers for New England and Middle States, to handle mechanical goods; liberal commission. Box 17, American Machinist.

Wanted—A first-class pattern maker; permanent position. Address Gaysport Foundry, Hollidaysburg, Pa.

Wanted—Position by man with 10 years' experience on motive power accounts, last part as chief clerk; best references. Box 24, Am. Machinist.

Wanted—A practical young man to solicit orders for an establishment doing a general foundry and machine business and dealing in machinery and supplies; state age, refs., experience, and salary expected. Address "Solicitor," care Am. Machinist.

✢ MISCELLANEOUS WANTS ✢

Advertisements will be inserted under this head at 35 cents per line, each insertion.

Crescent Boiler Tube Expander; second to none; price in reach of all. Crescent Mfg. Co., Cleveland, O.

The Crescent Link Belt Coupling; something new; sample free. Crescent Mfg. Co., Cleveland, O.

Light and fine machinery to order; Foot Lathe. Catalogue for stamp. E. O. Chase, Newark, N. J.

August C. Christensen, 24 State st., N. Y., consulting engineer for hydr. and pumping machinery, etc.

Small metal goods made to order, die work, etc. S. G. Metal Works, 528 North 10th st., Phila., Pa.

Correspondence solicited with parties having machine or foundry specialties to build. Honesdale Iron Works, Honesdale, Pa.

For Sale—One No. 1 Baker Blower, one each, 1½" 2½" Merriman bolt cutters, all new and complete. The McLagon Foundry Co., New Haven, Ct.

Wanted—To buy second-hand lathes, planers and shapers of all sizes; must be cheap and in good order. Fosdick & Plucker, 6th and Culvert Streets, Cincinnati O.

How to remove and prevent scale in steam boilers at a cost of ten cents a week. Send postal for circular to Pittsburgh Boiler Scale Resolvent Co., Pittsburgh, Pa.

Hardware, light machinery and models in brass, iron or steel made to order in small or large quantities. Catalogue of model supplies and tools free. Goodnow & Wightman, Boston, Mass.

For Sale—Pump Business. The very best rotary pump on the market, or would associate additional capital for enlarging the business. This pump has a splendid record, first-class testimonials and solid patent. From $3,000 to $6,000 takes patterns, stock on hand, orders, tools and patent. Address Pump, care American Machinist.

FOR SALE!

THE FACTORIES OF

The Hampden Watch Co.

AT SPRINGFIELD, MASS.,

Covering about one acre of ground, with Engine, Boiler, Shafting, etc., ready for immediate occupancy for light manufacturing. Address **Chas. D. Rood**, Prest, Springfield, Mass., or **Hampden Watch Co.**, Canton, Ohio.

OUR **NEW CATALOGUE OF TOOLS**

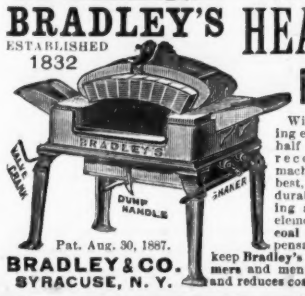
And Supplies sent free to any address on receipt of Ten Cents in stamps (for postage.)

Chas. A. Strelinger & Co., Wood Ave., Detroit, Mich.

BRADLEY'S UPRIGHT CUSHIONED HELVE HAMMER

Combines the best elements essential in a first-class **Hammer.** Has more good points, does more and better work and costs less for repairs than any other **Hammer** in the world.

BRADLEY'S HEATING FORGES.

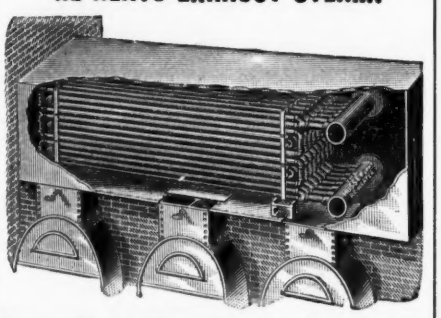


Pat. Aug. 30, 1887.

With a manufacturing experience of over half a century, we recommend these machines to be the best, simplest, most durable and combining all the essential elements. **For hard coal or coke.** Indispensable in all shops to keep **Bradley's Cushioned Hammers** and men fully employed and reduces cost of production.

BRADLEY & CO.
SYRACUSE, N. Y.

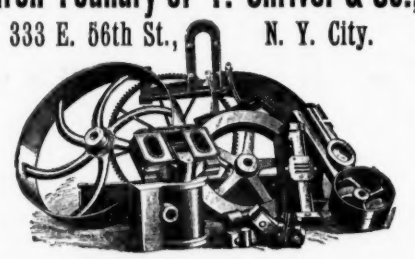
THE HUSSEY RE-HEATER
RE-HEATS EXHAUST STEAM.



Super-Heats Live Steam, Heats Air or Water
WITHOUT COST.

The Hussey Re-Heater and Steam Plant,
IMPROVEMENT CO.
A. S. Hatch, President.
S. D. Brewer, Gen'l Manager. 15 Cortlandt St, N. Y.

Iron Foundry of T. Shriver & Co.,
333 E. 56th St., N. Y. City.



Nice Castings, Smooth and True to Patterns, of very best brands of Pig Iron.
CASTINGS IN QUANTITY AT FAVORABLE PRICES.

ECONOMICAL STEAM BOILERS
A SPECIALTY.
SEND FOR PRICES. Pond Engineering Co. St. Louis, Mo.

"Star" Foot Lathe Swings 9x25 in. | LATHE | Screw Cutting Automatic Cross Feed, etc.
Scroll Saws, Circular Saws, Lathes Mortisers. | LATHE | Catalogue Free of all our Machinery.

Seneca Falls Mfg. Co. 687 Water St., Seneca Falls, N.Y

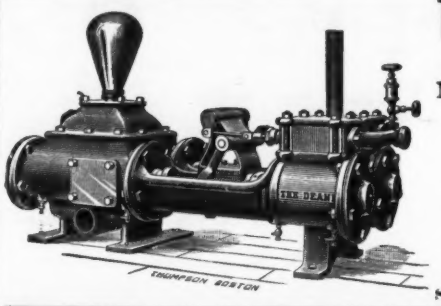
CHARLES MURRAY
ENGRAVER ON WOOD
58 ANN ST. ✻ NEW YORK.

FOR SALE, CORLISS ENGINES.

The **Fishkill Landing Machine Co.,** located at **Fishkill, on the Hudson, N. Y.,** offer to manufacturers and others desiring a well-built, economical and durable engine, their improved **CORLISS ENGINES.** They are endorsed by many reputable engineers and persons using them. Address as above.

IMPROVED PUMPING **MACHINERY** For Every Class of Work | Send for New Illustrated **CATALOGUE.**

THE DEANE STEAM PUMP CO.,
HOLYOKE, MASS.,
New York, Boston, Chicago, Philadelphia St. Louis,
Manufacturers of
STEAM and POWER
PUMPS
FOR ALL PURPOSES.



SEND FOR CATALOGUE.

The Hendey Geared Friction Planer,
16 inch x 16 inch x 4 feet.

For Die Work and use in Tool Rooms this planer is particularly adapted. It will plane accurately to a line, and stroke can be quickly changed from one inch to full capacity of table (4 feet), maintaining at the same time a uniform cutting speed. It has a cone pulley for change of speed, and automatic horizontal, vertical and angular feed. For above work it has proved a superior tool.

For Planers, Shapers or Engine Lathes, address
THE HENDEY MACHINE CO., TORRINGTON, CONN.

DON'T Decide the quality of any bar of steel by the appearance of its grain. The coarseness or fineness depends much more on the heat at which it left the hammer or rolls than on its quality. DON'T try to harden any bar of steel without first removing the scale from it. You will certainly be disappointed if you do, as the outside is likely to be soft enough to file easily.

SEND FOR CIRCULAR CONTAINING INFORMATION ABOUT STEEL TO
MILLER, METCALF & PARKIN,
64 & 66 SO. CLINTON STREET, CHICAGO, ILLS. | CRESCENT STEEL WORKS, PITTSBURGH, PA. | 480 PEARL STREET, NEW YORK, N. Y.

Sebastian, May & Co.'s Improved Screw Cutting FOOT AND POWER LATHES

Drill Presses, Shapers, Band, Circular and Scroll Saws. Machinists' Tools and Supplies. Lathes on trial. Catalogue mailed on application.
167 West Second Street, CINCINNATI, O.
OUR SPECIALTIES, 8, 12, 14 and 18 inch Lathes.

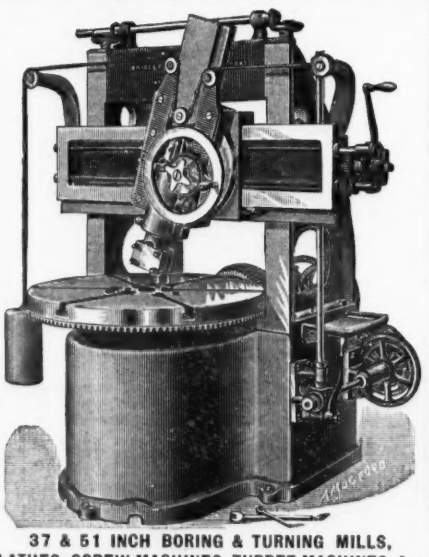
STEPHENS' PATENT VISES.

QUICK-ADJUSTING CAM AND TOGGLE JOINT.
Stationary or Patent Swivel Bases.
INCOMPARABLE FOR STRENGTH, DURABILITY, FIRM HOLD AND QUICK WORK.
Has improved Taper, Pipe and other attachments. Made in 2, 2¾, 3½, 4½, 5½, and 6½ inch width of jaw.
Sold by the Trade. Send for Circular.

TOWER & LYON, MFR'S,
95 CHAMBERS ST., NEW YORK.

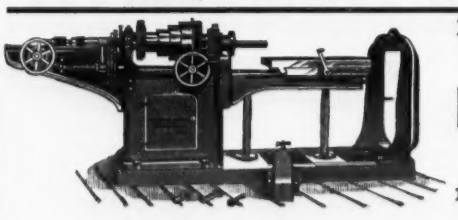
W. C. YOUNG & CO., Worcester, Mass. Manufacturers of
Engine Lathes, Hand Lathes,
FOOT POWER LATHES, SLIDE RESTS, ETC.

Bridgeport Machine Tool Works,
E. P. BULLARD, Prop.
Bridgeport, Conn.



37 & 51 INCH BORING & TURNING MILLS, LATHES, SCREW MACHINES, TURRET MACHINES, &c.

TANITE FOR SAW MILLS, FOUNDRIES AND MACHINE SHOPS
EMERY WHEELS and GRINDING MACHINES
For Circulars address
THE TANITE COMPANY, STROUDSBURG, MONROE CO., PA.
Or H. A. ROGERS, 19 John St., N. Y.



THE CELEBRATED
HEALD & SISCO CENTRIFUGAL PUMPS
Vertical and Horizontal.
COOKE & CO.,
22 Cortlandt St., New York.

In Writing Mention this Paper.

PATENT UNIVERSAL SCREW-CUTTING CENTER DEPTH ANGLE AND **J. WYKE & CO., TWIST DRILL GAUGE.**
Fine Machinists' Tools.—**E. Boston, Mass**—Send for Circular.

For an Illustrated Catalogue and Price List of the **FINEST LINE** of

VISES

made in the United States, address
ATHOL MACHINE CO., Man'frs,
ATHOL, MASS., U. S. A.

SOLDERING Iron and Steel may be done without causing **RUST** by using our **Non-Corrosive** Soldering Fluid.
Sample Bottle, prepaid, for 10 cents
FOR SALE BY ALL DEALERS.
STERLING ELLIOTT, NEWTON, MASS.

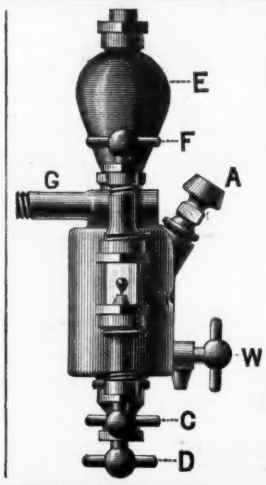
BETTS MACHINE COMP'Y,
WILMINGTON, DEL.,
MAKERS OF
Metal-working Machine Tools
OF SUPERIOR QUALITY,
FOR USE IN
MACHINE & RAILWAY SHOPS.

NICHOLSON FILE COMPANY,

PROVIDENCE, R. I.

Files and Rasps.

In magnitude, variety and excellence of product, this company has no equal in this, or any other country.



THE "VOLUNTEER" UP-DROP, SIGHT FEED, LUBRICATOR,

(GATES PATENT.)

FOR STATIONARY ENGINES AND PUMPS OF ALL KINDS. LUBRICATORS FOR SINGLE OR DOUBLE CONNECTION.

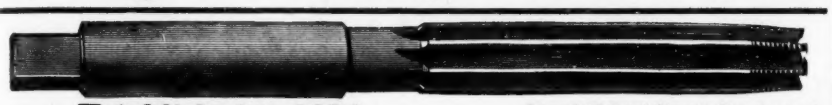
PRICE LIST.

Nos.	1	2	3
Price	$10.00	$12.00	$15.00
Capacity	⅓ pt.	½ pt.	¾ pt.

NATHAN MANUFACTURING CO.,

92 & 94 LIBERTY STREET, NEW YORK,

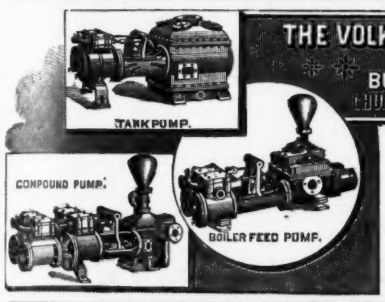
Send for Catalogue. SOLE MANUFACTURERS.



Established in 1874.

CLEVELAND TWIST DRILL CO.

24 and 26 West Street, Cleveland, O.
101 Chambers Street, New York.
85 Queen Victoria St., London, Eng.



THE VOLKER & FELTHOUSEN M'F'G. CO.

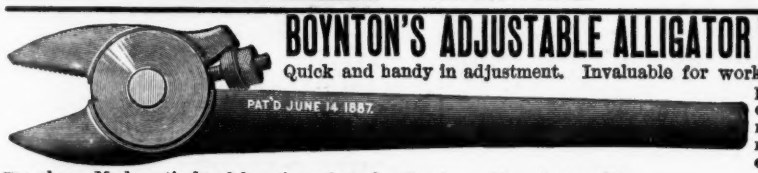
MANUFACTURERS OF

BUFFALO DUPLEX STEAM PUMPS.

CHURCH, BIRD AND MECHANIC STS. BUFFALO, N. Y.

For Sale at Factory Prices by

A. Aller, New York; Walworth Construction and Supply Co., Boston; Henry I. Snell, Philadelphia; Thos. J. Bell & Co., Cincinnati; Shaw, Kendall & Co., Toledo; The George Worthington Co., Cleveland; Gouids & Austin, Chicago; Kennedy & Pierce Machinery Co., Denver, Col.; Sheriff & Ashworth, Pittsburgh, Pa.; Jos. Baur, Manistee, Mich.; Jas. Jenks, Detroit, Wickes Bros., East Saginaw; Adolph Leitelt, Grand Rapids; E. F. Osborne & Co., St. Paul, Minn.; Rundle, Spence & Co., Milwaukee; Joshua Hendy Machine Works, San Francisco; Flynn & Emrich, Baltimore; Forbes, Liddell & Co., Montgomery, Ala.; Bailey & Lebby, Charleston, S. C.; Pond Engineering Co., St. Louis and Kansas City; O. B. Goodwin, Norfolk, Va.; Columbus Supply Co., Columbus, O.; U. S. Leeds & Co., Minneapolis; H. D. Coleman, New Orleans.



BOYNTON'S ADJUSTABLE ALLIGATOR WRENCH

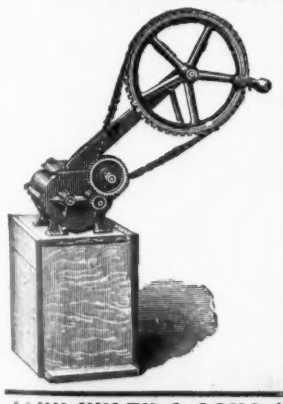
Quick and handy in adjustment. Invaluable for work on clipped pipe, in close coils and corners that cannot be reached with other wrenches. Made entirely of drop forged steel. Six sizes. Manufactured by

Campbell Printing Press & Mfg. Co.

160 WILLIAM ST., NEW YORK. 325 DEARBORN ST., CHICAGO.

ROOTS' NEW ACME HAND BLOWER.

For Blacksmiths, etc. Slow Speed, Positive Blast. Is Durable, Compact and Cheap; also Portable Forges, Tuyere Irons and Foundry Blowers.



P. H. & F. M. ROOTS, Mfrs.
CONNERSVILLE, IND.
S. S. TOWNSEND, Gen. Agt., 22 CORTLANDT ST., NEW YORK.
COOKE & CO., Selling Agts.,
Please Mention This Paper.

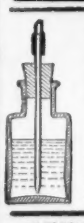
DELAFIELD'S PAT. SAW CLAMP.

With Saw for Cutting Metals. Saves all the broken hack-saw blades. In use over two years in all parts of the country. The new Clamps have the edges beveled that hold the saw. Free by mail for 50 cents. Extra blades, 1-2 in. wide, 7c. each, 70c. per dozen; 1 in. wide, Stubs, 35c. each. Free by mail.

NOROTON MFG. WORKS, NOROTON, CONN.

UNIVERSAL RADIAL AND RADIAL DRILLING MACHINES

THREE DESIGNS. SIX SIZES.
EMBODY ALL DESIRABLE FEATURES.
PRICES $450.00 & UPWARD
ADDRESS UNIVERSAL RADIAL DRILL CO
CINCINNATI, O. U.S.A.



KEUFFEL & ESSER, New York.

INDELIBLE DRAWING INKS.

Black, Brown, Blue, Green, Scarlet, Carmine, Yellow.

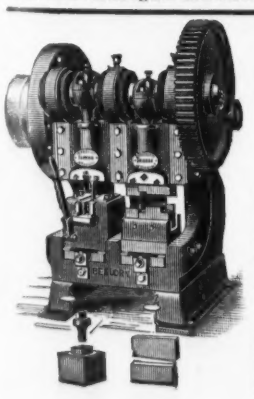
The best ever produced. Have our Patent Ink Filler, which regulates supply to pen; prevents soiling outside of pen-blades; is the only cleanly device for filling pens. Sample assortment, seven vials (of above colors), mailed on receipt of 50 cents.

JOHN WILEY & SONS, 15 ASTOR PL. NEW YORK.

PUBLISHERS OF

SCIENTIFIC AND INDUSTRIAL WORKS.

Send for Catalogues and Circulars.—Free by mail.



BEAUDRY'S DUPLEX Power Press

COMBINING PRESS, SHEARS AND PUNCH.

BEAUDRY & CO.

(Formerly of Beaudry's Upright Power Hammer.)

Sole Manufacturers.

Also manufacturers of

HARD COAL HEATING FORGES.

Room 4, MASON B'DG, 70 KILBY ST., Boston, Mass.

HENRY CAREY BAIRD & CO.,

Industrial Publishers, Booksellers and Importers,

810 Walnut St., Philadelphia.

☞Our New and Revised Catalogue of Practical and Scientific Books, 80 pages, 8vo., and our other Catalogues and Circulars, the whole covering every branch of Science applied to the Arts, sent free and free of postage to any one in any part of the world who will furnish his address.

Adjustable Clamping Blocks.

A simple device used to fill under clamps, when clamping work to various machines. Does away with lumber yards, scrap piles and confusion about your shops. Send for descriptive circulars and prices.

ENERGY M'F'G CO.,

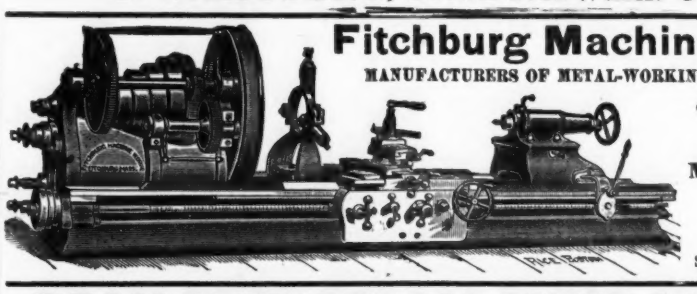
1115 & 1123 S. 15th STREET, - PHILA., PA.

REDUCED PRICES OF LeCOUNT'S STRAIGHT TAIL DOG.

To be driven from a Stud in the Face Plate.

No.	INCH.	PRICE.	No.	INCH.	PRICE
1	¾	$0.60	10	2¼	$1.35
2	⅞	.70	11	2½	1 45
3	1	.70	12	3	1.60
4	1⅛	.80	13	3½	1.80
5	1¼	.80	14	4	2.10
6	1⅜	.95	15	4½	2.75
7	1½	.95	16	5	3.25
8	1¾	1.10	17	5½	4 00
9	2	1.20	18	6	5 00
1 Set to 2 in.		7.80	Full Set		31.10

C. W. LeCOUNT, South Norwalk. Conn.



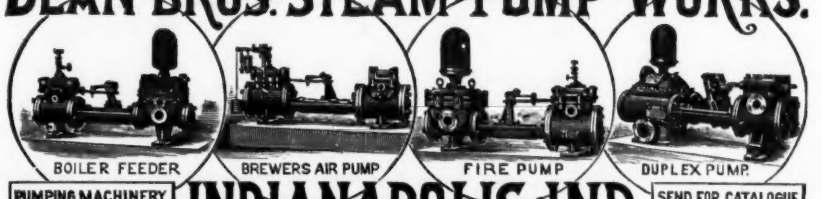
Fitchburg Machine Works

MANUFACTURERS OF METAL-WORKING MACHINERY.

OFFICE AND WORKS, 13 to 21 MAIN ST., Fitchburg, Mass.

SEND FOR CATALOGUE E.

DEAN BROS.' STEAM PUMP WORKS.



PUMPING MACHINERY FOR ALL PURPOSES. INDIANAPOLIS, IND. SEND FOR CATALOGUE AND PRICES.

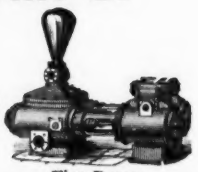
HALL DUPLEX STEAM PUMPS.

Send for New Catalogue.

Boiler and Pump Combined.

HALL STEAM PUMP CO.,

91 Liberty St., New York.



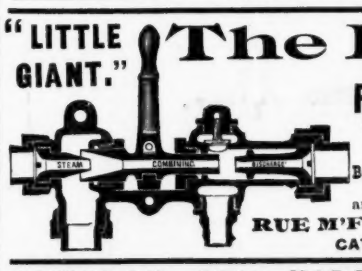
Fire Pump.

GUILD & GARRISON,

Kent Ave. and South 10th St., Brooklyn, N.Y.

Builders of Steam Pumps, Vacuum Pumps, Vacuum Apparatus, Filter-press Pumps, Air Compressors, Condensers for Pans, Engines, Steam Pumps, Etc.

"LITTLE GIANT."



The Best Injector.

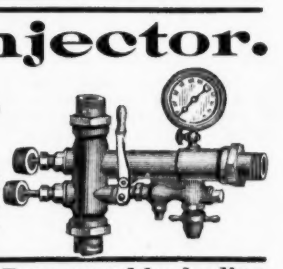
For Feeding all Steam Boilers.

RUE'S ● EJECTOR,

Superior to all others for Raising and Forcing Water and other Liquids.

Boiler Washer and Testing Device.

Uses Warm Water, avoiding injury and facilitating the Raising of Steam.



RUE M'F'G CO., PHILA., PA.

CATALOGUES FREE.

CAMERON SELF-HARDENING STEEL

Pronounced by leading mechanics the best steel made for cutting and shearing tools and turning steel tires. Try it. Satisfaction guaranteed.

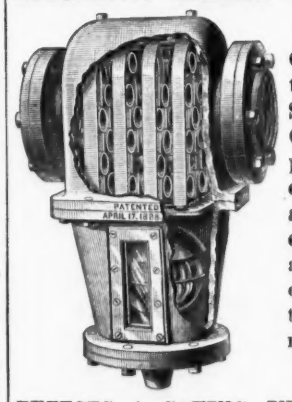
HOWE, BROWN & CO., LIMITED,

FORMERLY HUSSEY, HOWE & CO.

PITTSBURGH, PA.

BRANCH OFFICES: 12 Cliff St., N. Y. 127 Oliver St., Boston. 171 La Salle St., Chicago.

AUTOMATIC GREASE EXTRACTOR.



For removing Grease from the exhaust of **Steam Engines.** Causes no back pressure, yet **effectually separates entrained oil & grease,** and automatically delivers it to a suitable receptacle.

FFFECTS A SAVING IN FUEL, OIL, BOILER CLEANING AND REPAIRS.

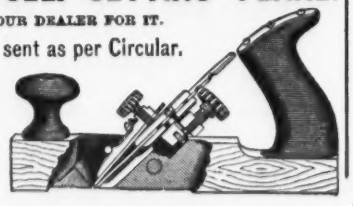
UNION STONE COMPANY,

38 & 40 HAWLEY ST., BOSTON, MASS. 36 JOHN ST., NEW YORK.

NEW SELF-SETTING PLANE.

ASK YOUR DEALER FOR IT.

Sample sent as per Circular.

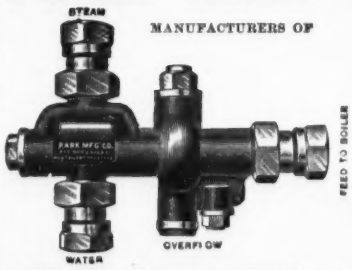


Gage Tool Co., Vineland, N. J.

PATENTS

THOMAS P SIMPSON, Washington, D. C. No atty's fee until Patent obtained. Write for Inventor's Guide.

PARK MFG. CO.



MANUFACTURERS OF

34 Beach Street, Boston, Mass.

The Park Injector,

EJECTORS AND JET APPARATUS.

WORTHINGTON Independent Condenser

ONLY APPARATUS that can MAINTAIN a VACUUM on ENGINES and ELEVATE the discharge WATER to TANK at any height

This feature is appreciated by PAPER MILLS SUGAR REFINERIES COTTON and WOOLEN MILLS

HENRY R WORTHINGTON

NEW YORK
BOSTON PHILADELPHIA
CHICAGO ST LOUIS SAN FRANCISCO

Boilers for Export, or for Use in Undeveloped Regions.

Packed for Transportation on Mule back, in Cases weighing not over 275 lbs.
Easily erected. Self-contained. No brickwork required.
No rivets, expanded joints, calked seams, or packing.

HARRISON SAFETY BOILER WORKS,
GERMANTOWN JUNCTION, PHILADELPHIA, PENNA.

"STEAM"

A VALUABLE BOOK FOR EVERY STEAM USER AND ENGINEER.

PUBLISHED FOR FREE DISTRIBUTION, BY

THE BABCOCK & WILCOX COMPANY,

MANUFACTURERS OF

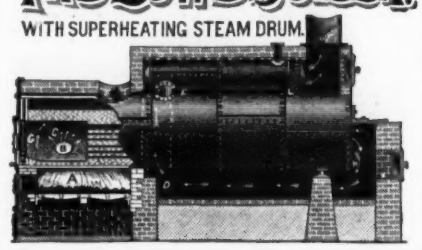
WATER-TUBE BOILERS,

107 Hope St., Glasgow. 30 Cortlandt St., N.Y.

THOS. H. DALLETT & CO.
1305 Buttonwood Street,
PHILADELPHIA, PA.
Portable Drills,
Hand Drills,
Boiler Shell Drills,
Light Drill Presses,
Special Machinery.
SEND FOR CATALOGUE.

THE LOWE BOILER.

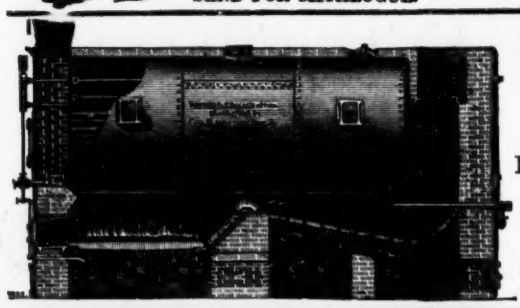
WITH SUPERHEATING STEAM DRUM.



Over fifty years' competition has proven this system of boiler to be the best in every respect. The **LOWE BOILER**, with all improvements, is the simplest, best wearing and most economical of any kind of fuel.

Send for description and histories of Steam Boilers and Feed Water Heaters (free) to

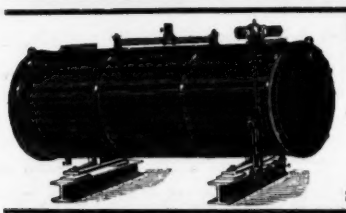
BRIDGEPORT BOILER WORKS,
BRIDGEPORT, CONN.



Weitmyer Patent Furnace,

Manufactured and Sold by
FOUNDRY AND MACHINE DEPARTMENT
For burning screenings, cheap fuel, etc.
HARRISBURG, PA.

Ide Auto. Engines. Portable and Traction Engines. Steam Road Rollers. Boilers of all descriptions.



The HOPPES Live-Steam Feed-Water Purifier,

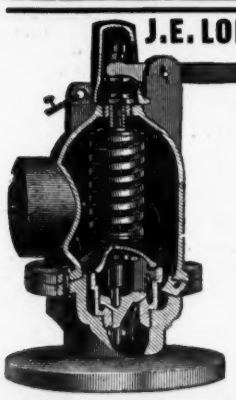
Guaranteed to Prevent Scale in Boilers,
Using any kind of water. Hard Sheet Steel Troughs, *Easily Cleaned.*

HOPPES MANUFACTURING CO.,
Send for Catalogue D. SPRINGFIELD, OHIO.

WM. BERKEFELD'S FOSSIL MEAL COMPOSITION.

THE BEST
Non-Conducting Covering for Steam Pipe and Boilers.
The only genuine Fossil Meal. Sold in bags of 110 lbs. each. Beware of imitations. Send for circulars.
Fossil Meal Co., 48 Cedar St., N. Y.
A. GIESE, Sole Proprietor.

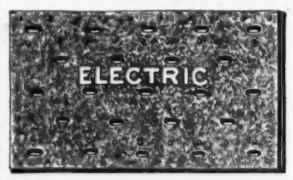
Trade-mark. W. B. C.



J.E. LONERGAN & CO.

211 Race St., Phila.
Manufacturers of
PATENT OILERS,
Cylinder Sight Feed Cups, Government Regulation
POP SAFETY VALVES
for Locomotive, Stationary and Marine Boilers, also the "Reliable" Steam Trap.
1888 Catalogue free on application.

ELECTRIC PERFORATED LEATHER BELTING!!



Prevents AIR Cushions. Guaranteed for *DYNAMOS*

Pat. May 24th, 1888.

CHAS. A. SCHIEREN & CO.,
(MANUFACTURERS.)
CHICAGO. PHILA. NEW YORK. BOSTON.

SWEET'S
Measuring Machine.
The only micrometer that will not lose its accuracy by wear.
Satisfaction Guaranteed.
SYRACUSE TWIST DRILL CO.
Syracuse, N. Y.

FRICTION CLUTCHES

For all Purposes.

W. OESTERLEIN, 137 W. 2d ST.,
CINCINNATI, OHIO.

—THE—
LAIDLAW & DUNN CO.

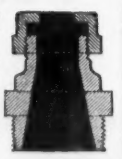
Purchasers of McGOWAN PUMP CO.
Established 1862.
CINCINNATI, O.
Manufacturers of
"Hero" Vertical
BOILER-FEEDERS,
"STANDARD"
DUPLEX PUMPS,
With Brass Removable Water Cylinders.
Send for Circulars.

BAILEY'S PATENT COPPER CAP FUSIBLE PLUG.

A Cheap Means for Preventing Accidents to Steam Boilers through Low Water.

The **fusible metal is kept from contact with the water,** thereby avoiding the chemical and mechanical action, which would otherwise prevent it from melting. Cap is readily removable, permitting free inspection.

Highly recommended by the chief Boiler Insurance Companies of Great Britain. Over 150,000 sold in Europe since first introduced, with increasing sales. Highly recommended also by the U. S. Board of Supervising Inspectors of Vessels at Washington, D. C; by Prof. R. H. Thurston, and many other eminent expert engineers, as superior to any now in use, and filling all requirements. Highly recommended also by a number of master mechanics.



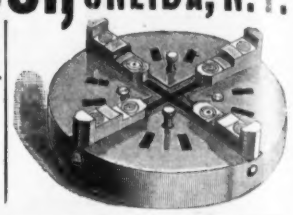
GEO. VAN WAGENEN, Sole American Licensee and Manufacturer.
Illustrated Pamphlets on Application. 233 West Street, New York City.

WESTCOTT CHUCK CO., ONEIDA, N.Y.

MANUFACTURERS OF
LATHE and DRILL
CHUCKS.
SEND FOR CATALOGUE.

GEARED CHUCKS.
Jaws Reversible.

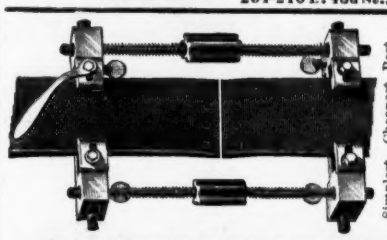
Diameter.	Capacity.
5 inch.	5 inch.
7½ "	7⅛ "
10⅛ "	10⅛ "
13 "	13⅛ "
15¼ "	17 "
18 "	19¾ "
21 "	25½ "
24 "	28 "



HYDROSTATIC MACHINERY

PRESSES,
PUMPS,
PUNCHES,
ACCUMULATORS,
JACKS,
VALVES,
FITTINGS,
Vault Elevators,
&c. &c.

Watson & Stillman,
204-210 E. 43d St., N.Y.



Simplest, Cheapest, Best. Strong, Light, Quickly Adjusted, Easily Used.

THE PORTER BELT CLAMP,
Manufactured by THE HOGGSON & PETTIS MFG. CO.
Established 1849. NEW HAVEN, CONN.

PINION KEY CHUCKS.

A geared scroll chuck with the pinion on the key shaft. It has been used for years by the largest electrical and instrument factories in the U. S. It is warranted durable and true. Ask for it at your dealer's.

THE D.E. WHITON MACHINE CO.
NEW LONDON, CONN.

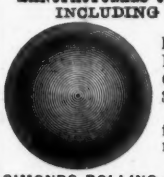
WELDLESS STEEL — QUICK OPENING GATE VALVE — COLD DRAWN TUBES

SMOOTH INSIDE & OUT.

JOHN S. LENG, 4 Fletcher St. N.Y.

WANTED TOOL AGENTS in Shops South and West of Penna. Send 10c. for Postage on Free Outfit.
C. B. JAMES, 98 Lake St., Chicago.
(Successor to E. H. RANDALL & Co.)

SIMONDS ROLLING MACHINE CO.,
MANUFACTURERS OF ROLLED FORGED SPECIALTIES,
INCLUDING
STEEL BALLS



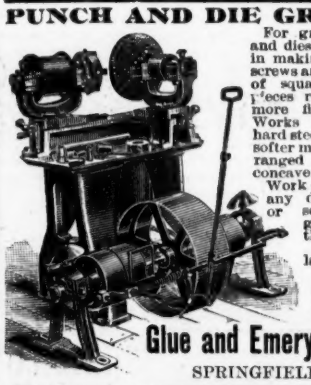
For Anti-Friction Bearings, of Best Cast Steel, Hardened, Ground and Burnished, from 3-16 in. to 2 in. diameter.
In quality and density of metal, in uniformity of temper, and in accuracy and nicety of finish warranted unequaled.
SAMPLES AND PRICES ON APPLICATION.
SIMONDS ROLLING MACHINE CO., Fitchburg, Mass.

TRADE MARK.
THE HORTON LATHE CHUCK!

Manufactured by
THE E. HORTON & SON CO.,
Windsor Locks, Conn., U. S. A.
Send for Illustrated Catalogue.

A NEW CATALOGUE OF
CUSHMAN CHUCKS
JUST ISSUED.
Containing new designs. Sizes and prices sent free on application to the
CUSHMAN CHUCK CO.,
HARTFORD, CONN.

PUNCH AND DIE GRINDER,



For grinding punches and dies, such as are used in making bolts, rivets, screws and a large variety of square or circular pieces requiring one or more finished faces. Works equally well on hard steel, chilled iron or softer metals. Can be arranged to grind convex, concave or flat surfaces. Work can be ground to any desired thickness or several pieces ground to same thickness.
Write for Circular.

Springfield Glue and Emery Wheel Co.,
SPRINGFIELD, MASS

PECK'S PAT. DROP PRESS.
NEW HAVEN.
BEECHER & PECK, CONN.

DROP FORGINGS OF IRON OR STEEL
BEECHER & PECK, NEW HAVEN CONN.

MACHINE TOOLS.

Special or General, any size, for the manufacture of Ordnance, Locomotive, Marine and Stationary Engines, Ships' Boilers, &c., supplied to many leading Firms in the United States of America.

Asquith's Patent Radial Drills

Unequaled by any in the World. Send specification of requirements. Large Stock of Tools ready for delivery.

W. ASQUITH, HALIFAX, England.

TRUMP CHUCK.

The Best and Cheapest Chuck made. Will hold **STRAIGHT** or **TAPER** Shank Drills **ACCURATELY.**
3 sizes: ⅛", ¼" and ⅜".

Write for Prices to

TRUMP BROS. MACHINE CO.,
WILMINGTON, DELAWARE.

Fit up your Boiler Shops, Bridge Works, Ship Yards, &c., with my "NEW" Standard

PUNCHES.

They will save you time and money.

I. P. RICHARDS, PROVIDENCE, R.I.

MACHINERY

For Reducing and Pointing Wire.
ESPECIALLY ADAPTED TO POINTING WIRE RODS AND WIRE FOR DRAWING.
For Machines or information, address the manufacturer,

S. W. GOODYEAR, Waterbury, Ct.

SEND FOR CATALOGUE.
WORCESTER MACHINE SCREW CO.

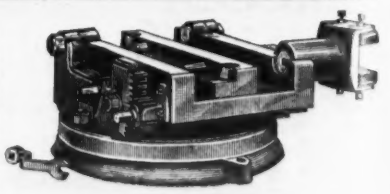
Manufacturers of Set, Cap and Machine Screws, Studs, etc.

MACHINIST'S SCALES,

PATENT END GRADUATION.
We Invite Comparison for Accuracy with all others.
EVERY SCALE GUARANTEED. SEND FOR LIST.
COFFIN & LEIGHTON, SYRACUSE, N. Y.

GREENWOOD'S UNIVERSAL PLANER CHUCK.

For Straight, Curved (Concave or Convex), or Angle Work Used on any Planer with Cross-Feed for Links, Wedges, Keys, etc. Indispensable for Locomotive Builders and Master Mechanics.



PEDRICK & AYER. 1025 Hamilton St., Philadelphia, Pa.

MORSE TWIST DRILL AND MACHINE COMPANY, New Bedford, Mass.

Manufacturers of **Morse Patent Straight-Lip Increase Twist Drills.**

Solid and Shell Reamers, Beach's Patent Self-Centering Chuck, Bit Stock Drills.

DRILL GRINDING MACHINES, MILLING CUTTERS AND SPECIAL TOOLS TO ORDER.

DRILLING MACHINES.

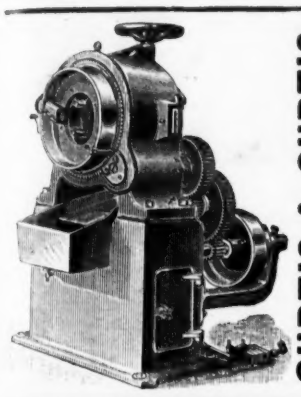
ALL STYLES WITH

Latest Designs and Improvements

For cuts and prices address,

BICKFORD DRILL CO.,

Front & Pike Sts., Cincinnati, O.



CURTIS & CURTIS,

66 CARDEN STREET,

BRIDGEPORT, - CONN.

Pipe Cutting and Threading Machinery,

FOR HAND OR POWER.

COMPLETE STEAM PUMP ONLY SEVEN DOLLARS

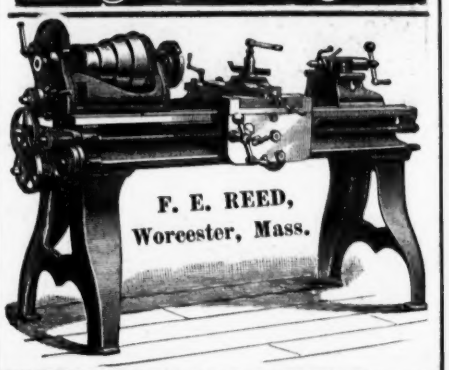
DEMAND THIS PUMP OF YOUR DEALER OR WRITE TO US FOR PRICES.

VAN DUZEN'S PATENT

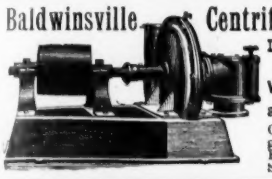
VAN DUZEN & TIFT.

SOLE MAKERS

CINCINNATI, O.



ENGINE Lathes, Hand Lathes, Foot Lathes, Upright Drills and Milling Machines. Agents, MANNING, MAXWELL & MOORE, 111 LIBERTY STREET, NEW YORK.



Baldwinsville Centrifugal PUMP WORKS.

IRVIN VAN WIE, Prop.

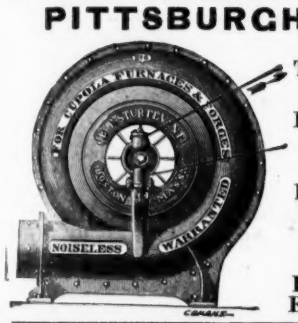
SYRACUSE, N. Y.

Vertical, Horizontal and Suction Pumps.

Capacity 100 to 40,000 gals. per minute. Sand Pumping Outfits a Specialty.

U. BAIRD MACHINERY CO.

PITTSBURGH, PA.



Machinists' TOOLS and SUPPLIES.

Pattern Makers' TOOLS.

Boiler Makers' TOOLS.

Sturtevant Blowers and Exhaust Fans.

PATENTS Secured for inventors. Terms moderate. Information free. ACKER & MORSELL, P. O. Box 707, Washington, D. C.

DIXON'S

SILICA

Graphite Paint

For Boiler Fronts and Smoke Stacks.

Two coats will last two years. Send for Circular. Equally good for all Iron Work exposed to extreme temperatures, salt air, acid fumes, etc.

Joseph Dixon Crucible Co.,

Manufacturers Pencils and Graphite Specialties.

JERSEY CITY, N. J.

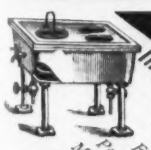
Patent CALCULATOR, For Engineers.

Mechanical. Marine. Electrical. Mining. Hydraulic. Heating. Sanitary. Military.

Naval Constructors Architects. Builders. Mechanics. Assayers. Chemists. Scientists. Students.

Size 10x3¾x1¼ in. Complete pocket book. All practical problems solved at sight. Mailed on receipt of 75 cents.

R. C. SMITH, No. 1 Broadway, N. Y.



Do You Use Glue?

Improved Steam Glue Heaters

without Joints, and therefore free from leakage. Furnished with plain Iron, Enameled Iron or Copper Pots. For Pattern Makers, Cabinet Makers, Joiners, Bookbinders, in fact, all who use Glue. Please mention this paper, and send for Price List to makers. Made in nineteen different styles.

PANCOAST & MAULE.

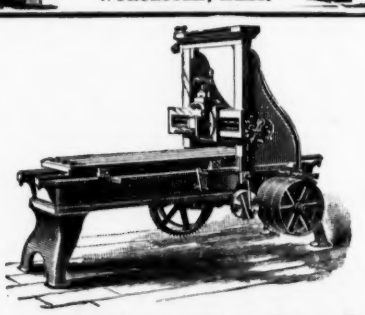
245 South Third Street, PHILADA. PA.

BUILD THESE

L. & M. STEEL & SPRING CO.

STEEL WIRE OF EVERY DESCRIPTION & STEEL SPRINGS.

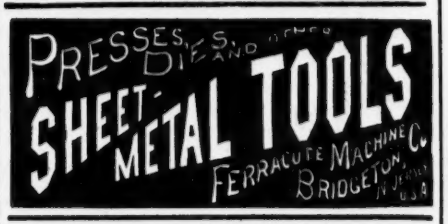
234 W. 29 ST. NEW YORK CITY



New Haven Manf'g Co.

NEW HAVEN, CONN.

IRON-WORKING MACHINERY.



MONTGOMERY & CO.,

105 FULTON ST., NEW YORK,

TOOLS, SUPPLIES AND MACHINERY

FOR ALL BRANCHES OF THE MECHANICAL TRADES.

Illustrated Catalogue (300 pages) mailed on receipt of Fourteen Cents.

L. S. STARRETT,

Manufacturer of

FINE TOOLS,

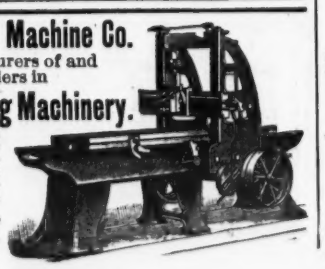
ATHOL, MASS.

SEND FOR FULL LIST.

L. W. Pond Machine Co.

Manufacturers of and Dealers in

Iron Working Machinery.



Improved Iron Planers a specialty. Feed, patented Feb. 9, 1886. Belt Shifter, patented Nov. 2, 1886.

140 Union St., Worcester, Mass.

McMAHON & COMPANY

MANUFACTURERS OF

Machinists' Tools,

AND

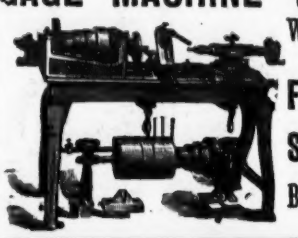
Patent Friction Pulleys,

Water St., Corner Lodge,

WORCESTER, - - MASS.

GAGE MACHINE WORKS,

Waterford, N.Y.



Manuf'r's of

FOX, TURRET AND SpeedLatnes AND Brass Finishers' TOOLS.

D. SAUNDERS' SONS

MANUFACTURERS OF THE ORIGINAL

TRADE **I. X. L.** MARK.

PIPE CUTTING & THREADING MACHINE.

BEWARE OF IMITATIONS.

None genuine without our Trade-Mark and Name.

Steam and Gas Fitters' Hand Tools. Pipe Cutting and Threading Machines for Pipe Mill use a specialty.

Send for Circulars. **YONKERS, N. Y.**

BUFFALO BLOWERS

FOR CUPOLAS, FORGES, FURNACES &C. EXHAUSTERS, STEAM FANS HEATERS & VENTILATING WHEELS.

BUFFALO FORGE CO. BUFFALO, N.Y.

MACHINE TOOLS.

24", 26", 32", 36", 42" and 56" Planers.

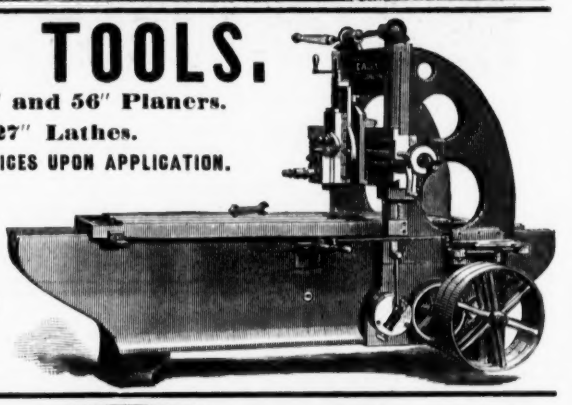
17", 20" and 27" Lathes.

CATALOGUE, PHOTOS AND PRICES UPON APPLICATION.

THE G. A. GRAY CO.,

477-479-481 Sycamore St.

These tools can now be seen at the Cincinnati Centennial Exposition, which closes October 27th.



POSITIVE PRESSURE OR BLAST BLOWER.

1. They are Cheaper than any other.
2. They are Equal in Capacity to larger ones of other makes.
3. Very Little Power is required to run them.
4. Exceedingly Simple in Construction.
5. Give a Positive Blast, and will drive air through the smallest aperture.
6. For Blow Pipe or Furnace they have no equal.

MANUFACTURED BY

GESSWEIN MACHINE CO.

OFFICE, 39 JOHN STREET, NEW YORK.

FRICTION CLUTCH PULLEYS AND CUT-OFF COUPLINGS

JAS. HUNTER & SON, North Adams, Mass.

SHAPING MACHINES

FOR HAND AND POWER.

6", 8" and 10" Stroke.

Adapted to All Classes of Work to their Capacity.

Circulars Furnished.

BOYNTON & PLUMMER,

WORCESTER, MASS.

COILS & BENDS

—OF—

IRON, BRASS and COPPER

PIPE.

ALL STYLES.

THE NATIONAL PIPE BENDING CO.,

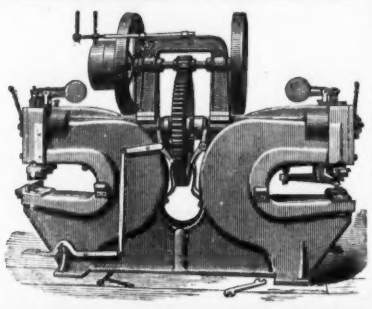
82 River Street, NEW HAVEN, CONN.

IT IS NOW TIME

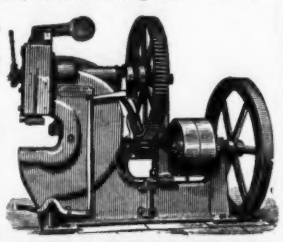
to order steam fittings, and in doing so, remember that our specialties have an established reputation for reliability and good workmanship.

MASON REGULATOR CO., BOSTON.

WILLIAM SELLERS & CO., Incorporated.
PHILADELPHIA, PA.
BUILDERS OF
MACHINE TOOLS FOR WORKING IRON AND STEEL,
Improved TURNTABLES for LOCOMOTIVES, CARS and PIVOT BRIDGES.
High Speed Power Traveling Cranes and Hand or Power Swing Cranes, Shafting, Pulleys, Hangers, &c., for transmission of power. Improved Self-Adjusting Injector of 1876. Self-Acting Injector of 1887. Fixed-Nozzle Automatic Injector of 1885.
INJECTORS for ALL CONDITIONS of LOCOMOTIVE and STATIONARY



THE LONG & ALLSTATTER CO. Hamilton, OHIO.
Double, Single, Angle-Bar, Gang, Horizontal, Twin, Boiler, Spacing, Gate, Multiple, Belt and Steam-Driven
Punches and Shears,
OVER 300 SIZES.
ALSO
Power Cushioned Hammer.
Send for New Catalogue.



All GENUINE INGOTS & MANUFACTURES BEAR OUR REG. TRADE MARKS.
"Phosphor-Bronze."
PHOSPHOR-BRONZE
INGOTS, CASTINGS & MANUFACTURES.
THE PHOSPHOR BRONZE SMELTING CO. LIMITED
512 ARCH ST. PHILADELPHIA PA. U.S.A.
ORIGINAL MANUFACTURERS OF PHOSPHOR-BRONZE IN THE UNITED STATES AND OWNERS OF THE U.S. PATENTS.

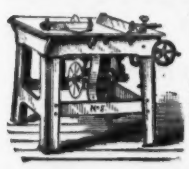
THE BECKETT FOUNDRY & MACHINE CO.
S. A. BECKETT, President. ARLINGTON, N. J. F. A. CHAPMAN, Sec. and Treas.
Successors to THE BECKETT & McDOWELL MFG. CO.
IRON FOUNDERS AND MACHINISTS.
MANUFACTURERS OF STEAM ENGINES AND GENERAL MACHINERY. SPECIALTIES: ORE-CRUSHING MACHINERY, STAMP MILLS AND MINING HOISTS.
Having Extensive Foundry Capacity, we are prepared to contract for regular supply of Machinery Castings.

PURE CARBON BRONZE.
Heavy Journal Bearings our Specialty.
Specially adapted for use on Steam Engines, Heavy Machinery, Locomotives, &c.
Look for brand, "Pure Carbon Bronze."
CARBON BRONZE CO.,
SOLE MANUFACTURERS,
38 WATER STREET, PITTSBURGH, PA.

FORGING AND WELDING BY PETROLEUM AIR BLAST FIRES.
GREAT ECONOMY OVER COAL. SCALING AVOIDED.

Wear of DIES lessened, and better work produced. Insurance not increased. No ASHES or CLINKERS. Continuous fire the whole day. Correspondence solicited.
AERATED FUEL CO., - Springfield, Mass.
J. H. BULLARD, Gen'l Manager.
ALDEN SPEARE'S SONS & CO., Boston, Mass., Agents for Eastern part of New England.
HARRIS & COWDERY, Ashtabula, Ohio, Agents for Ohio.

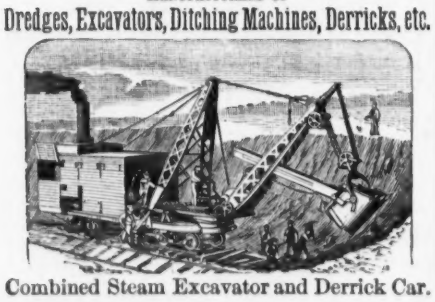
SEND FOR PHOTO OF OUR NEW AND IMPROVED
17 inch ENGINE LATHE,
COMPOUND REST AND TAPER ATTACHMENT.
HIGHEST GRADE OF WORKMANSHIP.
THE MULLER MACHINE TOOL CO.,
8TH and EVANS STREETS, CINCINNATI, OHIO.



Wood-Working Machinery
For Chair, Furniture and Cabinet Factories, Box Shops, Planing Mills, Pattern Makers' use, etc.
ROLLSTONE MACHINE CO.
45 Water St., Fitchburg, Mass.

BEVEL GEARS,
Cut Theoretically Correct.
For particulars and estimates apply to
HUGO BILGRAM,
Machinist,
Successor to
BREHMER BROS.
440 N. 12th St., Philadelphia, Pa.

OSGOOD DREDGE CO., Albany, N. Y.
RALPH R. OSGOOD, Pres. JAMES H. BLESSING, Vice-Pres.
JOHN K. HOWE, Secretary and Treasurer.
MANUFACTURERS OF
Dredges, Excavators, Ditching Machines, Derricks, etc.

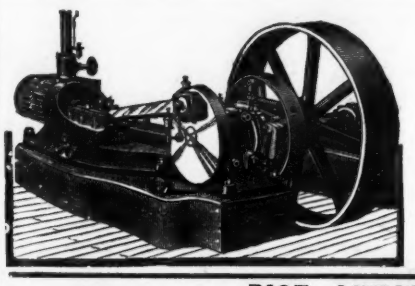


Combined Steam Excavator and Derrick Car.

"Prejudice has deprived us of Many Good Things."

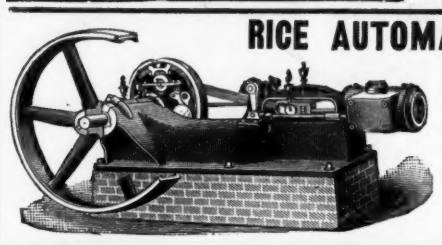
CORLISS SAFE MFG. CO.,
Providence, R. I., July 13th, 1888.
DETRICK & HARVEY, BALTIMORE, MD.
GENTLEMEN:—In accordance with the agreement we send you herewith * * * * in payment of Open Side Planer.
The planer is in operation and gives us satisfaction. It has been often examined and admired by the various parties visiting our works.
Yours truly,
CORLISS SAFE MFG. CO.,
HENRY W. WILKINSON, Treas.

BEMENT, MILES & CO.,
PHILADELPHIA, PA.
—BUILDERS OF—
METAL-WORKING MACHINE TOOLS
FOR
Railroad Shops, Locomotive and Car Builders, Machine Shops, Rolling Mills, Steam Forges, Ship Yards, Boiler Shops, Bridge Works, Etc., Etc.



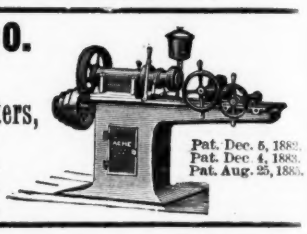
Russell & Co.
MASSILLON, OHIO,
BUILDERS OF
AUTOMATIC ENGINES
BOILERS, ETC.
Complete Power Plants Furnished and Erected.
SEND FOR CATALOGUE.

RICE AUTOMATIC CUT-OFF ENGINE.



Self-Contained. Sensitive Governor. Balanced Valve. High Speed. Stationary Oilers. Best Economy.
Gold Medal Cincinnati Exposition, 1884.
THE JOHN T. NOYE MFG. CO.,
BUFFALO, N. Y.

ACME MACHINERY CO.
CLEVELAND, OHIO.
Manufacturers of "ACME"
Single & Double Automatic Boltcutters,
Cutting from 3-8 in. to 6 in. diameter.
Also SEPARATE HEADS and DIES.
Send for Catalogues and Discounts.
Agents, Manning, Maxwell & Moore, New York.



TOOLS FOR MECHANICS
Chucks, Drills, Reamers, Screw-Plates, &c.
RAILROAD SUPPLIES.
+ NEW CATALOGUE NOW READY. +
PALMER, CUNNINGHAM & CO., L'd.
607 MARKET ST., PHILADELPHIA, PA.

STEEL CASTINGS
From 1-4 TO 15,000 lbs. WEIGHT.
True to pattern, sound, solid, free from blow-holes and of unequaled strength.
Stronger and more durable than iron forgings in any position or for any service whatever.
40,000 CRANK SHAFTS and 30,000 GEAR WHEELS of this steel now running prove this.
Cross-Heads, Rockers, Piston-Heads, etc., for Locomotives.
STEEL CASTINGS of every description.
Send for Circulars and prices to
CHESTER STEEL CASTINGS CO.,
Works, Chester. Pa. Office 407 Library St., Philadelphia, Pa.

FOR
SUBSTANTIAL, WELL MADE, LOW PRICED
20 INCH DRILLS,
With latest improvements, Lever or Wheel feed, address
Sibley & Ware,
SOUTH BEND - - INDIANA.

WILLIAM BARKER & CO.,

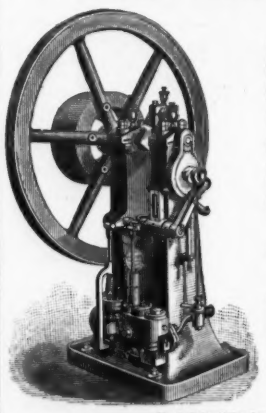
Manufacturers of
Iron and Brass Working
MACHINERY
140 & 142 E. Sixth St., Near Culvert,
CINCINNATI, O.

VOLNEY W. MASON & CO.,
Friction Pulleys, Clutches and Elevators,
PROVIDENCE, R. I.

Exhaust Tumbling Barrels.

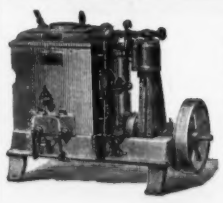
Henderson Bros.
MANUFACTURERS,
WATERBURY, CT.
SEND FOR CIRCULAR.

KORTING GAS ENGINE.
1 to 100 Horse Power.



The Korting Gas Engine is placed upon its merits and under full guarantee to every purchaser.
OVER 125 IN USE IN N. Y. CITY.
CATALOGUES on APPLICATION.
KORTING GAS ENGINE CO.,
LIMITED.
429, 431 & 433 Greenwich Street,
Cor. Laight Street, NEW YORK CITY.

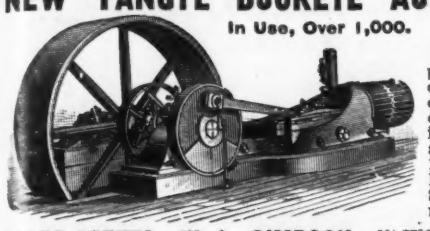
NO BOILER. NO STEAM. NO DANGER.
FUEL, CRUDE PETROLEUM OR KEROSENE
Started instantly with a match.
Cheaper than all others.
BINGHAMTON HYDRAULIC POWER CO.,
BINGHAMTON, N. Y., U. S. A.



NO DUST OR DIRT.
SHIPMAN
Automatic Steam Engine,
1, 2, 4, 6, & 12 H. P.
For Farmers, Printers, M'f'rs, pumping water, sawing wood, making ice cream, and for Launches. Illustrated Catalogue free. Mention this paper.
SHIPMAN ENGINE CO.,
92 Pearl St., Boston.

NEW TANGYE BUCKEYE AUTOMATIC CUT-OFF ENGINES.

In Use, Over 1,000. 25 to 1,000 H. P.



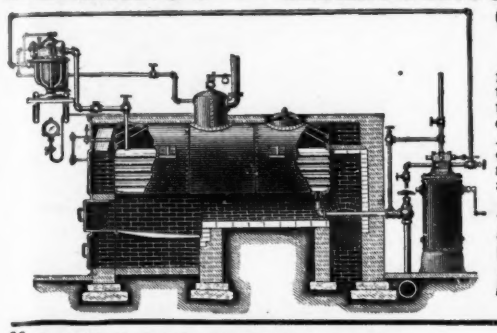
These engines are the combined result of long experience with automatic cut-off regulation, and most careful revision of all details. They are designed and constructed for heavy and continuous duty at medium or high rotative speeds. Highest attainable Economy in Steam Consumption and superior regulation guaranteed. Self-contained Automatic Cut-off Engines 12 to 100 H.P. for driving Dynamo Machines *a specialty*. Illustrated Circulars, with various data as to practical Steam Engine Construction and performance, free by mail. Address, BUCKEYE ENGINE CO., Salem, Ohio.

SALES AGENTS: **W. L. SIMPSON,** 301 TELEPHONE BUILDING, 18 CORTLANDT STREET, N. Y. / N. W. ROBINSON, 154 Washington St., Chicago, Ill. ROBINSON & CARY, St. Paul, Minn.

KENSINGTON ENGINE WORKS, LIMITED, PHILADELPHIA.

Sole Licensees and Manufacturers for New Jersey (South of Trenton), Eastern Pennsylvania, Delaware, Maryland and Virginia.

BLESSING'S WATER CIRCULATOR AND PURIFIER



Guaranteed to Absolutely Prevent Formation of Scale in Steam Boilers.

Automatically takes water from the boiler, filters, it, and returns it in pure condition, thus removing scale-making impurities from the water, and maintaining a free and steady circulation. Combines the well-known Albany Steam Trap with a Filter of novel construction, which has no rival in point of simplicity, facility for cleaning, and assurance against clogging of sand valve.

Send also for Circulars of Albany Steam Traps, Blessing's Renewable-Seat Stop and Check Valves, Pump Governors, Water Circulators and Purifiers, etc.

Albany Steam Trap Co., ALBANY, N.Y.

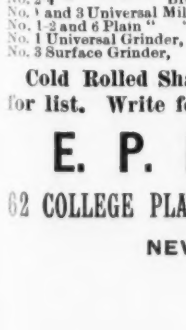
"OTTO" GAS ENGINE WORKS.

SCHLEICHER, SCHUMM & CO.,

33d & Walnut Streets, Philadelphia. 130 Washington Street, Chicago.

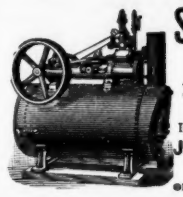
New York Agency, 18 Vesey St.

OVER 25,000 ENGINES SOLD.



HORIZONTAL "Otto" Gas Engines.
VERTICAL "Otto" Gas Engines.
TWIN CYLINDER "Otto" Gas Engines.
COMBINED "OTTO" GAS ENGINES AND PUMPS.
COMBINED "OTTO" GAS ENGINES AND DYNAMOS.

Consume 25 to 75 Per Cent. Less Gas than ANY other Gas Engine doing the same work.



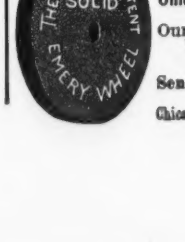
STEAM ENGINES

Upright and Horizontal, Stationary, Portable and Semi-Portable.

3 to 16 Horse Power.

Illustrated Pamphlet Free. Address

JAMES LEFFEL & CO. SPRINGFIELD, OHIO, or 110 Liberty St., New York.



THE **Metcalfe Standard Engines.**

Single-acting, Self adjusting, Self-lubricating, Noiseless, Automatic and Throttling. Especially adapted for continuous runs and direct connections to high speed machinery. Are well balanced, economical and compact. Built in sizes from 1 1-2 to 50 H. P.

J. T. METCALFE, Patentee & M'f'r, Quincy, Franklin Co., Penna.

SEND FOR CIRCULAR.

BALL AUTOMATIC CUT-OFF ENGINES,

ERIE, PA.

The characteristics of these Engines are Beauty of Design, Superior Finish, Limited Feet in Space required, Economy of Fuel, Perfection of Regulation.

CHARLES R. VINCENT & CO.,

NEW YORK SELLING OFFICE, 15 CORTLANDT STREET.

SIMPSON'S CENTRIFUGAL EXHAUST HEAD.

Thoroughly entraps water and grease from the exhaust of a steam engine without back pressure, preventing them from spraying on the sidewalks and roofs of buildings; it protects the latter from injury, and passers by from annoyance and damage. Send for circular to

KEYSTONE ENGINE & MACHINE WKS.,

5th and Buttonwood Sts., Phila., Pa.,

Or ARTHUR APPLETON, Selling Agent, 45 Cortlandt Street, N. Y.

MACHINERY ON HAND.

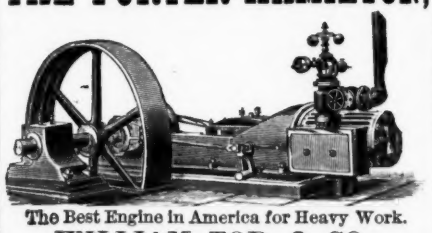
16 in. x 42 in.	Planer.	Bridgeport,	new.
22 in. x 4-5 and 6 ft.	"	Powell,	new.
24 in. x 6 ft.	"	Powell,	"
30 in. x 8 ft.	"	each Atherton, Powell & H. & P.	new.
36 in. x 12 ft.	"	Niles,	A 1.
38 in. x 14 ft.	"	Enterprise,	cheap.
12 in. x 5 1-2 ft.	Engine Lathe,	S. M. & Co.	new.
12 in. x 6 ft.	"	Young,	new.
13 in. x 6 ft.	"	Ames,	"
14 in. x 6 ft.	"	Blaisdell,	"
14 in. x 7 ft.	"	Bogart,	"
14 in. x 6 ft.	" Gap Bed,	S. M. & Co.,	"
15 in. x 6 and 8 ft.	"	Porter,	"
16 in. x 6 and 8 ft.	"	Blaisdell,	new
16-20 in. x 6-8-10 & 12 ft.	"	Bridgeport,	"
18 in. x 8-10-12 ft.	"	Different Makes,	"
20 in. x 8-10-14 ft.	"	Different Makes,	"
20 in. any length Bed	"	Bridgeport,	"
22 in. x 12 ft.	"	Niles,	heavy, good.
22 in. x 8-10-12 & 14 1-2	"	Bridgeport,	new.
26 in. x 12 ft.	"	Wright,	new.
24 in. x 14 & 20 ft.	"	Ames,	"
36 in. x 14 ft.	"	Fifield,	"
20 in. Drill		Davis,	"
20-23-25-28 inch Drills		Blaisdell,	"
20-25-28-32 inch	"	C. & S.	"
5 ft. Arm Universal Radial Drill,			"
Cabinet Turret Lathe, Lodge, Davis & Co.			"
No. 5 Screw Machine, Jones, Lamson & Co.			"
No. 2-4 " "	Brown & Sharpe.		"
No. 2 and 3 Universal Miller,	Brown & Sharpe,		"
No. 1-2 and 6 Plain "	"	"	"
No. 1 Universal Grinder,	"	"	"
No. 3 Surface Grinder,	"	"	A 1.

Cold Rolled Shafting in Stock. Send for list. Write for what is wanted.

E. P. BULLARD,

62 COLLEGE PLACE & 72 WARREN ST., NEW YORK.

THE PORTER-HAMILTON,



The Best Engine in America for Heavy Work.

WILLIAM TOD & CO., Youngstown, Ohio.

The Armstrong Mfg. Co.

BRIDGEPORT, CONN.

Water, GAS AND STEAM Fitters' Tools.

STOCKS AND DIES FOR PIPE, BOLTS AND BRASS PIPE WRENCHES, PIPE VISES, ETC.

— SEND FOR CATALOGUE. —

BAKER'S COMMON SENSE OIL FILTER.

Is the most **Simple, Neat, Ornamental, Effective, Complete** and **Convenient OIL FILTER** in the Market. The whole **operation** is **visible,** and any ordinary man can operate it **successfully.** It will pay for itself the first year, if a little pains is taken to catch the waste oil from your Engine, Dynamo, Shafting, etc., etc. Manufactured and for sale by **CHAS. F. BAKER,**

223 Third Ave., S. E., Minneapolis, Minn.

Sterling Emery Wheel Co.,

Factory, West Sterling, Mass.

Office, 17 Dey Street, New York.

Our Wheels for Machine Shop Work and Tool Grinding Superior to all others.

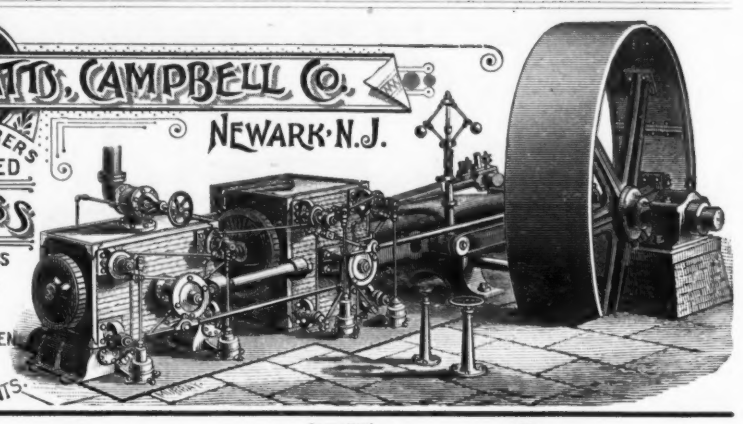
Send for Catalogue just published.

Chicago Office, 41 South Canal St., Chicago, Ill.

THE WATTS, CAMPBELL CO.

MANUFACTURERS OF IMPROVED CORLISS STEAM ENGINES IN FULL VARIETY.

NEWARK, N.J.

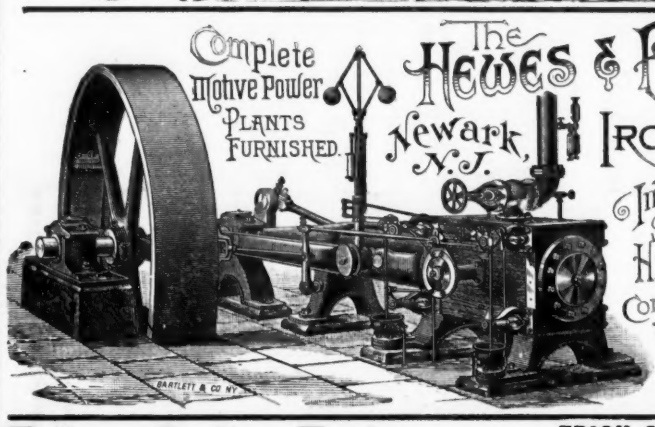


CONTRACTS TAKEN FOR COMPLETE POWER PLANTS.

The HEWES & PHILLIPS IRON WORKS

Complete Motive Power Plants Furnished.

Newark, N.J.



Improved CORLISS ENGINES. High Pressure, Condensing and Compound TUBULAR BOILERS.

GEO. A. BARNARD AGENT.

Eclipse Corliss Engine.

FRICK COMPANY, Builders, WAYNESBORO, PA.

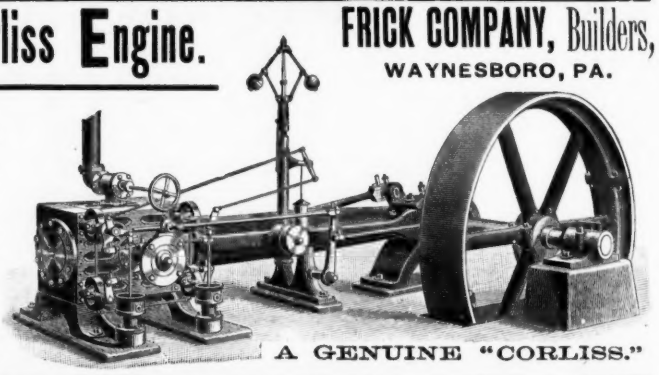
NON-CONDENSING, CONDENSING COMPOUND.

40 TO 1,000 H.P.

Send for Circulars.

E. P. HAMPSON & CO., 36 CORTLANDT ST., NEW YORK, Sole Eastern Agents.

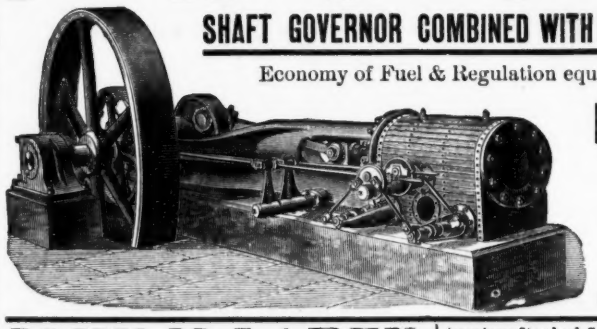
JOHN J. METZGER, 69 S. Clinton St., Chicago, WESTERN AGENT.



A GENUINE "CORLISS."

PAYNE HIGH SPEED CORLISS ENGINE.

SHAFT GOVERNOR COMBINED WITH CORLISS WRIST-PLATE.



Economy of Fuel & Regulation equal to anything in use.

B. W. PAYNE & SONS,

ELMIRA, N. Y.

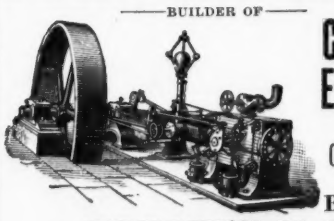
45 Dey St., New York.

Hill, Clarke & Co., Boston, Mass.

10 S. Canal St., Chicago, Ill.

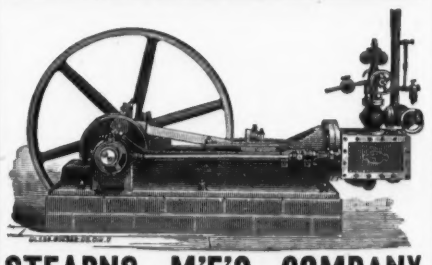
JOHN McLAREN,

— BUILDER OF —



CORLISS Engines, AIR Compressors and BOILERS.

HOBOKEN, N. J.



STEARNS M'F'G COMPANY,

ERIE, PA.

ENGINES from 15 to 400 Horse Power.

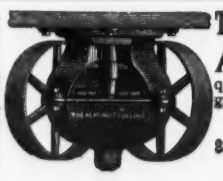
Boilers of Steel and Iron supplied to the trade or the user. Send for Catalogues.

SAW MILLS and GENERAL MACHINERY.

Works at Erie, Pa.

New York Store, 46 Cortlandt Street,

BARNHURST & DURLIN, Managers.



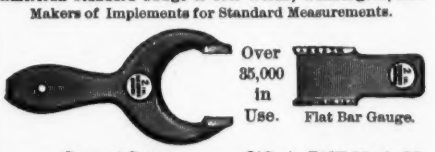
The Almond Coupling

A NEW quarter turn motion to replace quarter turn belts and bevel gears.

T. R. ALMOND, MFR., 83 and 85 Washington Street, BROOKLYN, N. Y.

American Standard Gauge & Tool Works, Wilmington, Del.

Makers of Implements for Standard Measurements.



Over 35,000 in Use.

Crescent Gauge. Flat Bar Gauge.

JAS. A. TAYLOR & CO.

HILL, CLARKE & Co.

156 OLIVER STREET, BOSTON, MASS.

NOW READY, ILLUSTRATING

MACHINERY

For Working and Cutting Iron, Brass, and Steel,

OUR 1888

Catalogue

Contains 420 Pages, over 200 fine Wood Cuts, nearly all new and made specially for this book.

Price, each, $5.00.

(Copies will be sent, without expense, to all our customers, also to owners of machine shops, and intending purchasers, who may apply for them.)

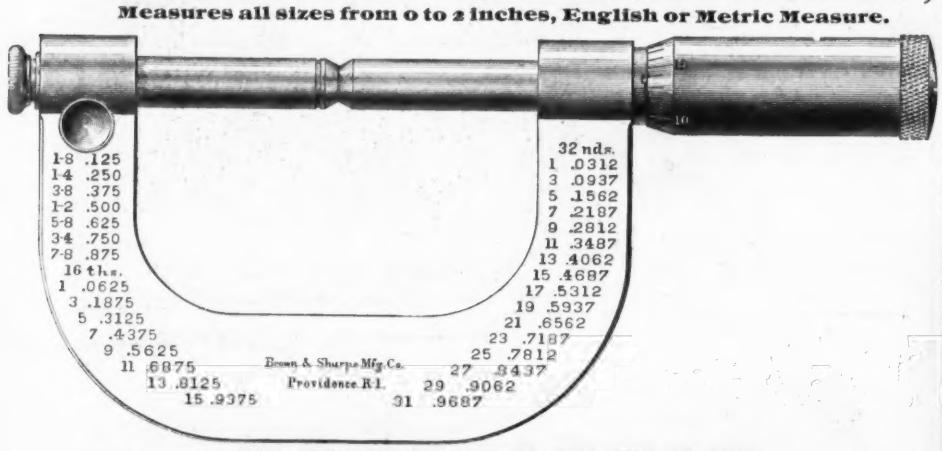
HILL, CLARKE & Co.

156 OLIVER STREET, BOSTON, MASS.

BROWN & SHARPE MFG. CO., PROVIDENCE, R. I.

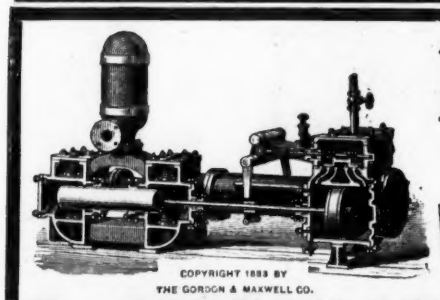
MICROMETER CALIPER No. 30,

Measures all sizes from 0 to 2 inches, English or Metric Measure.



PAT. APRIL 23, 1878, JAN. 22, 1884, AUG. 16, 1887.

PRICE, $8.00. IN MOROCCO CASE, $9.00.



COPYRIGHT 1888 BY THE GORDON & MAXWELL CO.

Duplex Steam Pumps AND Water Works Machinery.

THE GORDON STEAM PUMP CO.

HAMILTON, OHIO.

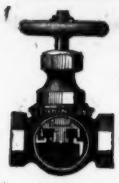
BRANCH HOUSES:

NEW YORK, 96 Liberty Street.
PHILADELPHIA, 705 Arch Street.
CHICAGO, 96 Lake Street.

CRANES

THE YALE & TOWNE MFG CO.
STAMFORD CONN.
NEW YORK CHICAGO PHILA. BOSTON

IMPORTANT TO USERS OF VALVES.



Owing to the popularity the JENKINS BROS. VALVES have attained, the market has been subjected to BASE IMITATIONS.

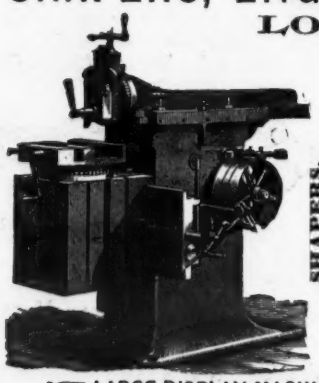
One important defect in the imitations referred to is *insufficient opening* for inlet *of steam or* Fluid, *thereby checking the flow.* Purchasers of Valves should be careful to know that they are of capacity suited to size of pipe to which the Valves are to be attached. All Valves manufactured by

Jenkins Bros. are Warranted Full Opening.

JENKINS BROS., 71 John St., N. Y. 105 Milk St., Boston. 21 North Fifth St., Phila. 54 Dearborn St., Chicago.

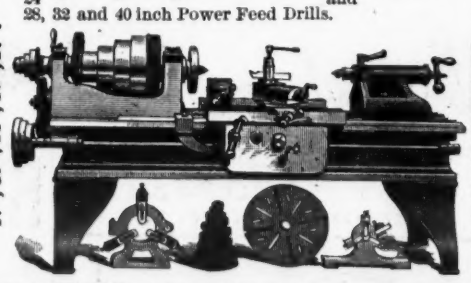
SHAPERS, ENGINE LATHES AND DRILLS.

LODGE, DAVIS & CO.,
CINCINNATI, OHIO



SHAPERS, 8", 10", 15", 20", 26", 32" Stroke.
ENGINE LATHES, 17", 19", 21", 24", 27".

20 inch Upright Drills. 25 inch Back Geared.
24 " " " and
28, 32 and 40 inch Power Feed Drills.



WRITE FOR PRICES, IT WILL PAY YOU.

☞ LARGE DISPLAY MACHINE TOOLS AT CINCINNATI CENTENNIAL EXPOSITION.

E. GOULD & EBERHARDT,

NEWARK, N.J.

Eberhardt's New Drill

Turns out 20 per cent. more work than any other. APPLY TO

GEAR AND RACK CUTTING TO ORDER.

E. E. GARVIN & CO.

139 & 141 CENTRE ST., NEW YORK,

Manufacturers of MACHINISTS' TOOLS

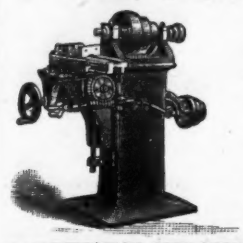
Small Automatic Miller, WITH ARM.

The Machine shown in cut is designed for rapid and convenient milling of small work.

Send for Catalogue.

THE PRATT & WHITNEY CO.

Hartford, Conn.



Manufacture Plain Milling Machines, with hand and power feed, of several sizes. Index, double face, vertical face, double spindle and shuttle race Milling Machines. Cam Cutters and Profiling Machines of several kinds. Milling Machines, Vises and Centers. Milling Cutter and Twist Drill Grinding Machines.

RACK AND GEAR CUTTING MACHINES.
KNURLING TOOLS. CUTTERS FOR THE TEETH OF SPUR WHEELS.

WESTERN BRANCH, 100 WEST WASHINGTON ST., CHICAGO, ILLS.

THE BILLINGS & SPENCER CO.

HARTFORD, CONN. U.S.A.

MANUFACTURERS OF BILLINGS' DROP FORGED LATHE DOGS FORGED FROM BEST STEEL FOR THE PURPOSE

IN 12 SIZES 3/8 UP TO AND INCLUDING 4 IN. ALSO CLAMP AND DIE DOGS

DROP FORGINGS OF COPPER, IRON AND STEEL OF ALL DESCRIPTIONS.

WARNER & SWASEY,

CLEVELAND, OHIO,

MACHINE TOOLS

For Iron and Brass Work.

SMALL TOOLS & FIXTURES.

Gear Cutting in all its Branches.

ILLUSTRATED CATALOGUE ON APPLICATION.

GEO. W. FIFIELD,

MANUFACTURER OF

ENGINE LATHES

FROM 16 to 48 IN. SWING.

Cuts, Photographs and Prices furnished on application.

Lowell, Mass., U. S. A.

Gear Wheels and Gear Cutting.—I make g to order, or cut teeth on g blanks sent to me. Of all kinds. Of all sizes to six ft. dm. Small orders or large ones. Fine g or cheap g. Small cast g. Ready made brass g by mail at low prices. Bevel g with perfect planed teeth. Hand Book on g, $1. Facilities complete. Terms reasonable. Send for cat.
GEO. B. GRANT, 66 Beverly St., Boston, Mass.

KEY-SEATING MACHINES AND 20 in. Drills a Specialty.

Our 20 in. Drill is a heavy substantial tool, made for service, has steel shafts and spindle. Gears and racks cut from the solid, and have all modern improvements, are made by special machinery, and sold very low.

Our Key-Seating Machine will save enough in 60 days' use to pay first cost; no shop can afford to do without one. We have now ready for prompt shipment, both Key-Seat Machines and 20 in. Drills. Send for Photo. and Catalogue.

W. P. DAVIS, North Bloomfield, N. Y.

REMOVAL.

THE POND MACHINE TOOL COMPANY,
Formerly of Worcester, Mass.

The new shops of this company are located at Plainfield, N. J., forty minutes' ride from New York city on the line of the Central Railroad of N. J., and consist of the following:

A machine shop 500' long by 100' wide; a foundry 250' long by 90' wide; also commodious buildings for the storage of sand, coal, coke and pig iron; ample and convenient wash rooms for the men; fireproof two story pattern storage; blacksmith shop; engine and boiler houses. These buildings are detached from the machine shop and foundry. There is an elevated railroad for the convenient distribution of raw materials, and a railroad running through the machine shop for shipping. The whole plant is supplied with the incandescent system of electric lighting.

The machine shop and foundry have overhead traveling cranes running through their entire lengths; also light traveling cranes, which serve every tool, and a number of jib cranes in the foundry and scratch rooms. The foundry has capacity for making the heaviest class of castings.

All our tools are expressly designed for the economical manufacture of heavy machinery for railroad and general machine shop equipment, from new patterns of the latest and best designs.

SALESROOM and OFFICE, 111 & 113 Liberty St., N. Y. City.
NEW SHOPS, Plainfield, N. J.

HARTFORD STEAM BOILER INSPECTION AND INSURANCE CO.
HARTFORD, CONN.

J. M. ALLEN, PRESIDENT.
W. B. FRANKLIN, VICE-PRESIDENT.
J. B. PIERCE, SECRETARY.

NEW CATALOGUE

MACHINE TOOLS.

THE G. A. GRAY CO.,
477-481 SYCAMORE ST., CINCINNATI, O.

See advertisement, page 13.

STEEL CASTINGS.

PRATT & LETCHWORTH,
PROPRIETORS
Buffalo Steel Foundry,
BUFFALO, N. Y.

PUNCHING PRESSES, DIES,

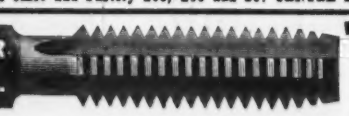
And other Tools for the Manufacture of all kinds of

SHEET METAL GOODS, DROP FORGINGS, —ETC.— DROP HAMMERS.

STILES & PARKER PRESS CO.
MIDDLETOWN, CONN.

Branch Office and Factory 203, 205 and 207 CENTRE STREET, NEW YORK.

J.M.CARPENTER
PAWTUCKET.R.I.



Manufacturer —of— TAPS & DIES